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Permeable Reactive Treatment (PeRT) Wall Characterization Report

September 1998

MRAP 00111 AR 604 4-35 PeRT WALL
PERMEABLE REACTIVE TREATMENT (PeRT) WALL
CHARACTERIZATION REPORT 9/98



U.S. Department
of Energy

Permeable Reactive Treatment (PeRT) Wall

Characterization Report

September 1998

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Albuquerque Operations Office
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1.0 Introduction

This report presents and discusses results of a subsurface investigation conducted in May and June 1998 to support the design and construction phases of the Monticello Permeable Reactive Treatment (PeRT) project, Monticello, Utah. The objective of this investigation was to determine bedrock depths, water table elevations, subsurface lithology, and uranium concentrations in ground water, in the immediate vicinity of the proposed PeRT wall. Relevant data obtained during the Monticello Mill Tailings Site (MMTS), Operable Unit (OU) III remedial investigation have also been incorporated.

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2.0 General Setting

The project area is located in the central portion of a valley through which a small perennial stream (Montezuma Creek) flows. The creek flows west to east at rates typically about 1 cubic foot per second or less, although significantly higher flows occur during spring runoff and storms. The creek banks are steep in the project area and rise about 10 ft above the stream stage. On the north side of the creek, the valley floor is relatively flat in width (north-south) for approximately 250 ft. North of the flat area, the ground surface rises sharply about 25 feet (ft) above the valley floor, and then becomes moderately sloped over the next several-hundred feet. South of the creek, the ground surface rises gradually over a distance of 200 to 300 ft. On both sides of the creek, but beyond the immediate area of interest, the valley is bounded by steep bedrock hillslopes.

Within the central portion of the valley, 10 to 20 ft of unconsolidated deposits overlie bedrock. The unconsolidated materials consist of a layer of fine, sandy silt that overlies approximately 5 to 8 ft of alluvial sand, gravel, and cobbles. Ground water is present in the alluvial materials and forms a shallow and relatively narrow water table aquifer. The direction of ground-water flow is regionally from west to east, parallel to the trend of the valley, but varies considerably on a local scale. In the project area, the alluvial aquifer is underlain by about 35 ft of interbedded mudstone, siltstone, sandstone, and occasional coal seams of the Dakota Sandstone Formation. The bedrock topography generally mimics that of the ground surface. Bedrock in the project area strikes approximately due north and dips about 1 degree to the east.

The Dakota Sandstone Formation is an aquitard that separates the alluvial aquifer from the underlying sandstone aquifer within the Burro Canyon Formation. The PeRT wall will be constructed in the alluvial aquifer, which is contaminated by mill tailings-related constituents. The Burro Canyon sandstone aquifer is not contaminated.

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3.0 Field Program

Subsurface conditions were investigated for the PeRT project during May and June 1998 at the 19 locations shown in Figure 3-1. At each location, a 2-in o.d. core sampler was advanced using a hydraulically powered direct push/percussion probe rig (Geoprobe® Systems, Model 4200). Manufacturer specifications indicate a hydraulic pressure of 2000 psi, 16,000 lb of down pressure, and percussion rate of 30 Hz for the model used. Also shown in Figure 3-1 is the location of the PeRT wall as currently proposed and the locations of other previously installed boreholes and monitoring wells.

Each probe hole completed during the 1998 investigation was extended into bedrock, however continuous core sampling of the unconsolidated deposits was not performed and therefore a complete record of subsurface lithology and individual bed thickness was not obtained. The core sampling was conducted to complement the detailed lithologic data obtained during 1992 (see below) and to provide additional depth to bedrock and bedrock lithology information. A test pit was also excavated in May 1998 in the area immediately north of PW98-03 and PW98-04 to provide lithologic information. The pit measured approximately 5 ft wide by 12 ft long and 15 ft deep.

Temporary piezometers were installed at each probe location for water level measurement and ground-water sample collection. Piezometers were constructed of 0.5-in diameter by 5-ft PVC screen (#10 slot) and casing sections, with threaded bottom plugs and slip-joint caps. The assemblies were installed either through the probe rods or open hole. The base of the screens were set at or within 1-ft of the bedrock surface, if possible. Annular space was backfilled with #10 - 20 silica sand to within 6-in of the ground surface. The remaining space was plugged with 0.25-inch bentonite chips that were hydrated with potable water.

All piezometers were surveyed for location and elevation (ground surface and top of casing) based on the Monticello Project Coordinate System. Borehole information and piezometer placement information is summarized in Tables 3-1 and 3-2, respectively. Piezometers PW98-01 through PW98-07 were abandoned on July 27, 1998. Casing and screen were manually pulled and the boreholes were backfilled with granular bentonite to ground surface. Abandonment of the remaining piezometers is pending. Borehole and piezometer completion logs are included in the appendices.

In 1992, eight borings associated with the OU III remedial investigation were completed in the area of interest using a truck-mounted drill rig and hollow-stem augers (see Figure 3-1). Augering and continuous sampling was conducted until refusal in the bedrock. A 140-lb drop hammer with a 30-in drop was used to drive a 3-in o.d. by 24-in long split spoon sampler ahead of the auger bit to collect samples. The sampler was driven 24-in or until sampler refusal (≥ 50 blows for 6-in penetration). Observation wells were installed at several locations. Borehole and well completion logs from the 1992 investigation are also included in the appendices.

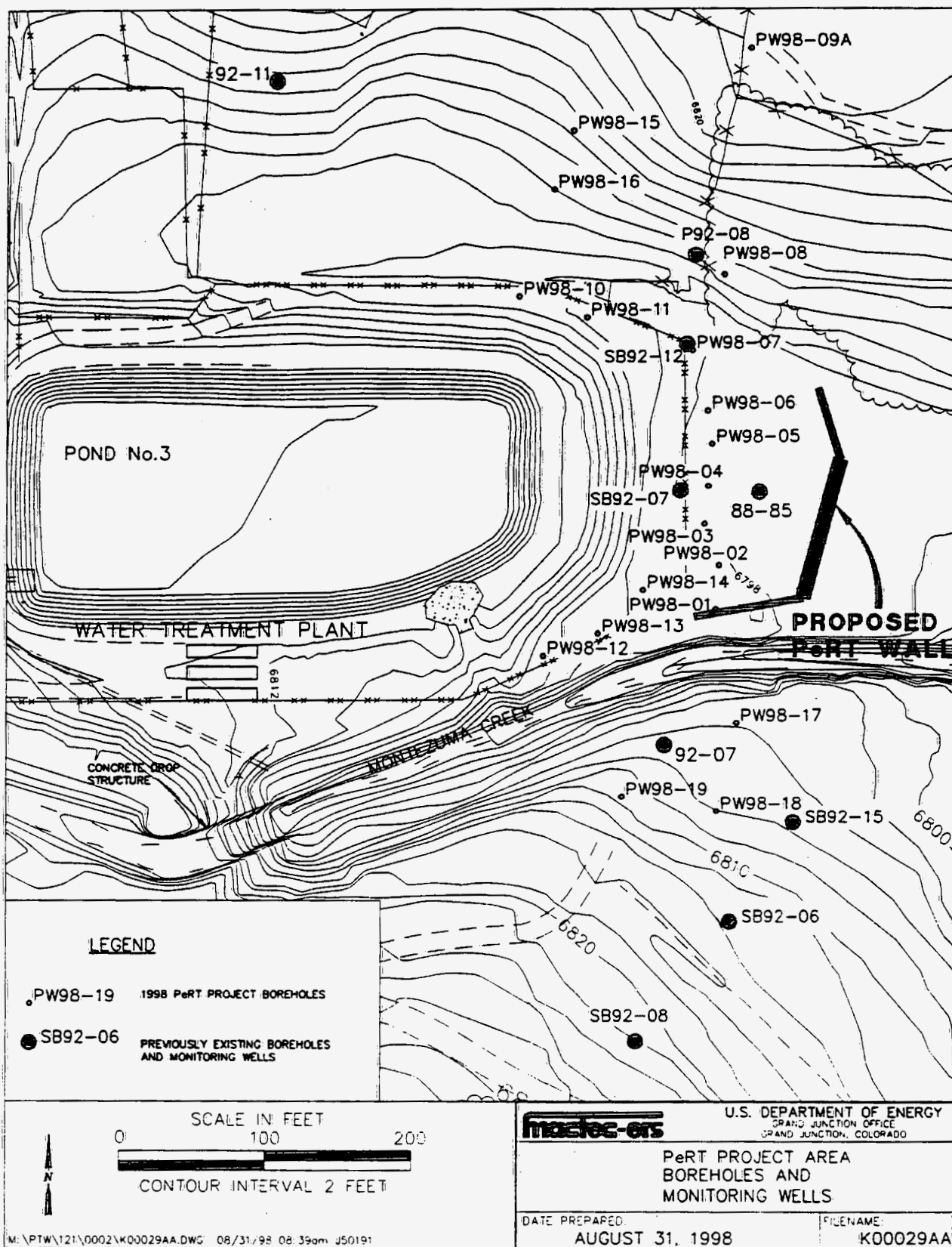


Figure 3-1. PeRT Project Area Boreholes, Piezometers, and Monitoring Wells

Table 3-1 Borehole Summary Data

Borehole	Date Completed	Northing	Easting	Ground Elev. [ft]	Hole Depth [ft]
PW98-01	5/28/98	10254.22	23954.26	6798.3	15.5
PW98-02	5/28/98	10287.32	23954.23	6798.1	15.5
PW98-03	5/28/98	10315.28	23946.81	6797.2	16
PW98-04	5/29/98	10339.84	23947.84	6797.4	16
PW98-05	5/29/98	10368.75	23948.01	6797.3	13
PW98-06	5/29/98	10391.19	23945.01	6797.7	14
PW98-07	6/01/98	10431.53	23935.08	6798.6	16
PW98-08	6/02/98	10485.35	23956.43	6805.3	18
PW98-09A	6/02/98	10638.78	23974.43	6822.7	12.5
PW98-10	6/02/98	10469.83	23816.40	6802.3	16
PW98-11	6/02/98	10453.82	23864.19	6801.3	17
PW98-12	6/03/98	10223.02	23837.14	6803.1	20
PW98-13	6/03/98	10239.13	23874.66	6800.5	17
PW98-14	6/03/98	10269.20	23904.94	6799.1	15.5
PW98-15	6/04/98	10582.83	23855.55	6810.3	14
PW98-16	6/04/98	10541.67	23841.38	6805.7	20
PW98-17	6/08/98	10178.12	23965.47	6801.3	19.5
PW98-18	6/08/98	10118.72	23953.77	6804.0	23.5
PW98-19	6/09/98	10125.03	23889.96	6807.5	25

Table 3-2 Piezometer Summary Data

Piezometer	Elev. Top of Casing [ft]	Stickup [ft]	Top of Screen bgs [ft]	Base of Screen bgs [ft]	Depth to Bedrock bgs [ft]
PW98-01	6799.44	1.14	8.9	13.9	14.3
PW98-02	6798.64	0.54	8.2	13.2	13.8
PW98-03	6797.56	0.36	9.6	14.6	14.1
PW98-04	6798.19	0.79	6.7	11.7	12.5
PW98-05	6798.10	0.80	5.8	10.8	11.5
PW98-06	6798.30	0.60	8.1	13.1	12.3
PW98-07	6800.17	1.57	8.4	13.4	14.3
PW98-08	6805.85	0.55	11.7	16.7	16.5
PW98-09A	6823.19	0.49	6.6	11.6	12
PW98-10	6803.99	1.69	8.3	13.3	13.8
PW98-11	6802.43	1.13	9.4	14.4	16.4
PW98-12	6804.14	1.04	14	15	18.4
PW98-13	6801.36	0.86	10.2	15.2	16.3
PW98-14	6800.61	1.51	8.5	13.5	14.5
PW98-15	6810.87	0.57	5.8	10.8	10.8
PW98-16	6806.81	1.11	10.3	15.3	16.8
PW98-17	6801.42	0.12	13.4	18.4	18.5
PW98-18	6803.94	-0.06	15.5	20.5	21.1
PW98-19	6807.51	0.01	19.5	24.5	24.8

bgs = below ground surface.

4.0 Results

4.1 Lithology of Unconsolidated Materials

The unconsolidated deposits in the PeRT project area consist of a layer of fine sandy silt that overlies saturated granular alluvium (sand, gravel, and cobbles). The Geoprobe® rig experienced little difficulty penetrating the upper layer of fine grained material, which was typically 6 to 10 ft thick in the valley floor north of the creek. The penetration rate through the fine materials (without sampling) was on the order of ≥ 1 foot per minute (ft/min).

Probe penetration of the underlying granular materials was successful at each location but required additional time and effort. Probing was hampered mainly when cobbles were encountered, often requiring 5 or 10 minutes of driving to displace or break an individual cobble.

In the absence of cobbles, the penetration rate of the probe (without sampling) was about 0.5-ft/min. Cobbles were encountered at most or all locations. Observations of test pit spoils indicated that the alluvial materials were primarily mixtures of sand and fine to coarse gravel (0.19 - 2.9 in, Unified Soil Classification System [USCS]) with some cobbles (2.9 - 11.8 in, USCS). The largest materials exhumed were two boulders that measured approximately 2 to 2.5 ft in length by 1.5 ft in diameter.

Along the base of the slope at and north of PW98-08 and PW98-15 (Figure 3-1), the upper layer of fine grained materials and basal sand and gravel layer terminates against colluvial deposits that consist of a mantle of cobbles with interstitial silt and sand that overlies sandy silt with clay and some gravel. Thin layers of peat and silty clay containing abundant organic carbon were encountered near the bedrock surface at locations PW98-08 and PW98-15. At PW98-09A, located on the terrace above the slope break, the cobble layer extended 12 ft to bedrock. The cobble layer was approximately 5 ft thick at PW98-15. As indicated in Figure 3-1, the PeRT wall is not expected to extend into this area of cobbles. A summary of the subsurface lithology and blow count information obtained during the 1992 investigation is presented as Table 4-1.

4.2 Bedrock Lithology

The upper bedrock at all but 3 locations (see below) probed during 1998 consisted of mudstone or siltstone within the middle portion of the Dakota Sandstone Formation. The probe penetrated up to 2 ft of bedrock at some locations. The upper 0.5 to 1 ft interval typically consisted of soft, cohesive, moist to wet clay that was easily penetrated. This upper interval was often weathered to a yellowish gray color. At some locations the upper bedrock was a medium stiff clay that was only slightly moist and more difficult to penetrate. With depth, the material generally graded to a dark gray, medium stiff to stiff clay with lower moisture content and greater resistance to penetration. The total thickness of the upper mudstone beds and the lithology of the underlying beds cannot be determined from the available data.

Table 4-1 Summary of 1992 Borehole Data

Borehole	Thickness of Fine Grained Layer [ft]	Thickness of Granular Layer [ft]	Blow Counts/6-in, Fine Grained Layer	Blow Counts/6-in, Granular Layer
88-85	7	5.5	15 to 21	>50
92-07	14	6.3	5 to 13	18 to 40
92-11	8	6	2 to 16	18 to 38
P92-08	4.5	6.5	6 to 38	16 to 55
SB92-06	26	4	4 to 18	20 to 32
SB92-07	6	7	3 to 15	22 to >50
SB92-08	27	3.5	7 to 15	33 to >50
SB92-12	6	7.5	2 to 12	18 to 29
SB92-15	17	4	3 to 10	18 to 46

Interbedded coal stringers were present within the 1.5 ft interval of dry mudstone recovered at PW98-15. At PW98-09A, 0.5 ft of dry coal/carbonaceous mudstone was recovered. Bedrock recovery at location PW98-03 consisted of 0.1 ft of dry carbonaceous mudstone or coal. The upper bedrock at each of the 1992 borehole locations also consisted of gray mudstone and siltstone, except at SB92-08, where dense sandstone was encountered. The sandstone layer occurs at a higher elevation than the mudstones encountered in the central portion of the valley floor (see Figure 4.5-2). Augering was generally discontinued about 0.5 ft into the bedrock but up to 1.5 ft were penetrated at locations 92-07 and P92-08.

4.3 Depth to Ground Water

Depth to ground-water measurements taken in piezometers and existing monitoring wells in the project area during June and July 1998 are summarized Table 4.3-1. During that period, the elevation of the water table decreased from its highest position on June 9 to its lowest on July 22. The depth to water increased between about 0.5 to 0.7 ft at most locations. However, at locations PW98-08 and PW98-16, which are along the northern margin of the area investigated, water levels decreased by approximately 1 to 1.8 ft. Between July 22 and July 27, 1998, water levels increased on the order of 0.1 ft. Ground water was not present at locations PW98-09A and PW98-15 at any time.

Figure 4.3-1 illustrates the depth to ground-water below ground surface on June 19, 1998. Ground water was shallowest across the central portion of the valley floor between PW98-03 and PW98-07, ranging between approximately 4.5 and 5.5 ft below ground surface (June 19, 1998). At the remaining locations north of the creek, the depth to ground water varied between approximately 8.5 and 15 ft. Depth to ground water generally decreased with distance away from Pond 3. South of Montezuma Creek, the depth to ground water ranged from 16 to 22 ft.

Table 4.3-1 Ground-Water Level Summary Data

Piezometer/Well	6/09/98			6/19/98			6/24/98			7/16/98			7/22/98			7/27/98		
	DTW btoc [ft]	DTW bgs [ft]	Elev WT [ft]	DTW btoc [ft]	DTW bgs [ft]	Elev WT [ft]	DTW btoc [ft]	DTW bgs [ft]	Elev WT [ft]	DTW btoc [ft]	DTW bgs [ft]	Elev WT [ft]	DTW btoc [ft]	DTW bgs [ft]	Elev WT [ft]	DTW btoc [ft]	DTW bgs [ft]	Elev WT [ft]
PW98-01	9.95	8.8	6789.49	10.08	8.9	6789.36	10.15	9.0	6789.29	10.53	9.4	6788.91	10.54	9.4	6788.90	10.49	9.4	6788.95
PW98-02	7.51	7.0	6791.13	7.59	7.1	6791.05	7.68	7.1	6790.96	8.14	7.6	6790.50	8.15	7.6	6790.49	8.10	7.6	6790.54
PW98-03	4.99	4.6	6792.57	5.20	4.8	6792.36	5.37	5.0	6792.19	5.92	5.6	6791.64	5.93	5.6	6791.63	5.88	5.5	6791.68
PW98-04	5.59	4.8	6792.60	5.79	5.0	6792.40	5.97	5.2	6792.22	6.51	5.7	6791.68	6.55	5.8	6791.64	6.48	5.7	6791.71
PW98-05	5.18	4.4	6792.92	5.39	4.6	6792.71	5.59	4.8	6792.51	6.16	5.4	6791.94	6.19	5.4	6791.91	6.12	5.3	6791.98
PW98-06	5.30	4.7	6793.00	5.53	4.9	6792.77	5.73	5.1	6792.57	6.31	5.7	6791.99	6.33	5.7	6791.97	6.29	5.7	6792.01
PW98-07	7.08	5.5	6793.09	7.25	5.7	6792.92	7.46	5.9	6792.71	8.07	6.5	6792.10	8.09	6.5	6792.08	8.04	6.5	6792.13
PW98-08	11.99	11.4	6793.86	12.28	11.7	6793.57	13.08	12.5	6792.77	13.78	13.2	6792.07	13.82	13.3	6792.03	13.78	13.2	6792.07
PW98-09A	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
PW98-10	9.87	8.2	6794.12	10.11	8.4	6793.88	10.33	8.6	6793.66	11.03	9.3	6792.96	11.10	9.4	6792.89	10.99	9.3	6793.00
PW98-11	8.74	7.6	6793.69	8.94	7.8	6793.49	9.15	8.0	6793.28	9.83	8.7	6792.60	9.88	8.8	6792.55	9.79	8.7	6792.64
PW98-12	14.77	13.7	6789.37	14.87	13.8	6789.27	14.99	14.0	6789.15	15.24	14.2	6788.90	15.25	14.2	6788.89	15.18	14.1	6788.96
PW98-13	11.41	10.6	6789.95	11.52	10.7	6789.84	11.61	10.8	6789.75	11.94	11.1	6789.42	11.97	11.1	6789.39	11.91	11.1	6789.45
PW98-14	9.38	7.9	6791.23	9.52	8.0	6791.09	9.64	8.1	6790.97	10.07	8.6	6790.54	10.10	8.6	6790.51	10.05	8.5	6790.56
PW98-15	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
PW98-16	12.24	11.1	6794.57	12.50	11.4	6794.31	12.75	11.6	6794.06	13.46	12.4	6793.35	13.49	12.4	6793.32	13.41	12.3	6793.40
PW98-17	16.27	16.2	6785.15	16.42	16.3	6785.00	16.56	16.4	6784.86	16.79	16.7	6784.63	16.80	16.7	6784.62	16.72	16.6	6784.70
PW98-18	18.75	18.8	6785.19	18.98	19.0	6784.96	19.02	19.1	6784.92	19.49	19.6	6784.45	19.47	19.5	6784.47	19.26	19.3	6784.68
PW98-19	21.55	21.5	6785.96	20.14	20.1	6787.37	21.32	21.3	6786.19	21.36	21.4	6786.15	21.50	21.5	6786.01	21.13	21.1	6786.38
88-85	7.28	6.9	6790.23	7.41	7.0	6790.10	7.53	7.1	6789.98	7.69	7.3	6789.82	7.87	7.5	6789.64	7.42	7.0	6790.09
92-11	15.97	15.2	6797.76	nm	nm	nm	16.38	15.7	6797.35	nm	nm	nm	16.73	16.0	6797.00	nm	nm	nm
92-07	18.82	16.6	6787.03	18.62	16.4	6787.23	18.71	16.5	6787.14	nm	nm	nm	19.03	16.8	6786.82	19.05	16.8	6786.80

DTW, btoc = depth to groundwater, below top of casing.
DTW, bgs = depth to groundwater, below ground surface.
Elev WT = elevation of water.
nm= not measured

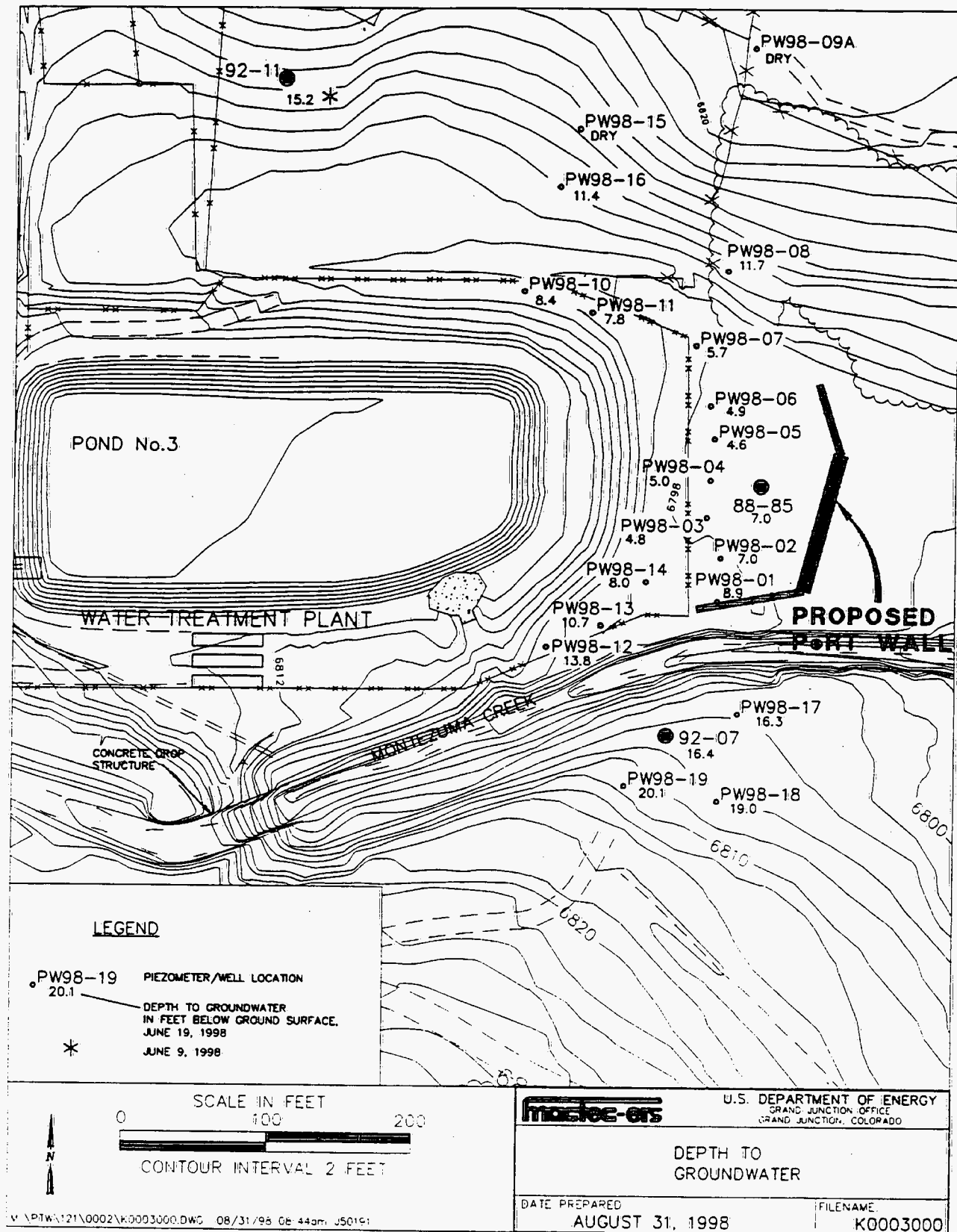


Figure 4.3-1. Depth to Ground Water Below Ground Surface, June 19, 1998

Since November 1992, the depth to ground water at well 88–85 has fluctuated between ± 1 ft from an approximate mean of 7.5 ft below ground surface, except during April through July 1993, when ground water rose to within 1.5 ft of the surface. Similar peak water levels also occurred at wells 92–11 and P92–08, but not at 92–07 (see hydrographs in appendices), however, the July 1993 measurement at well 92–07 is suspect. Although hydrographs for many other site monitoring wells exhibit relatively high water levels during mid-1993, leakage from a stock pond formerly in the Pond 3 area may have contributed to the high water levels of 1993 in wells 92–11, 88–85, and P92–08. Construction of Pond 3 was completed during the summer of 1994.

4.4 Depth to Bedrock

Depth to bedrock and bedrock elevation results are presented in Table 4.4–1 and illustrated in map view in Figures 4.4–1 and 4.4–2, respectively. The depth to bedrock in the center of the project area (locations PW98–01 through PW98–07) ranges from 11.5 to about 14.5 ft below ground surface. The ground surface and bedrock surface in that area are relatively flat. Along the slope break between PW98–08 and PW98–16, the depth to bedrock increases slightly to approximately 16.5 to 17 ft. Immediately north of those locations, the bedrock surface rises significantly. In the vicinity of the proposed south funnel section of the PeRT system (locations PW98–01 and PW98–14), the depth to bedrock is approximately 14.5. The bedrock surface gradually slopes down to the southeast from the north side of Montezuma Creek in the area of investigation and then rises steeply approximately 250 ft south of the creek near location SB92–08. The bedrock surface is approximately 3 to 4 ft below the creek bed in the project area. At the eastern base of the drop structure however, Dakota Sandstone is believed to outcrop in the creek bed.

The available data indicate that the saturated thickness of the aquifer south of the creek (approximately 2.5 to 4 ft) is generally several feet less than on the north side (approximately 5.5 to 9.5 ft). This may be due to the close proximity of the piezometers to mounded ground water around Pond 3, or a broadening of the bedrock valley south of the creek. The saturated thickness of the alluvial aquifer is shown in map view in Figure 4.4–3 for June 19, 1998, and in tabular form in Table 4.4–2 for each measurement event. Locally, the northern limit of the aquifer is interpreted to coincide with the slope break in ground surface and bedrock topography that extends from PW98–15 to immediately north of PW98–08, and then for an undetermined distance east along the base of the cobbled terrace deposit (see Figure 4.4–3).

4.5 Ground-Water Flow

Figure 4.5–1 illustrates the surface of the alluvial aquifer based on the June 19, 1998 measurement data. Comparing Figure 4.5–1 and 4.4–2 indicates that the water table surface and corresponding direction of ground-water flow (perpendicular to ground-water elevation contour lines) is strongly influenced by the topography of the bedrock surface. The prominent feature of the water table map is the change in the direction of flow from predominantly southeast in the area northwest of the PeRT wall to south-southeast in the vicinity of 98–03 and 98–14. Ground water then flows beneath Montezuma Creek from the north in a south-southeasterly direction. The creek intersects the water table but is not an aquifer discharge or recharge boundary, although some seepage to and from the stream banks is likely. On the south side of the creek, the direction of flow again becomes southeast to east-southeast.

Table 4.4-1 Bedrock Surface Summary Data

Borehole	Ground Elev. [ft]	Depth to Bedrock, bgs [ft]	Bedrock Elev. [ft]
PW98-01	6798.3	14.3	6784.0
PW98-02	6798.1	13.8	6784.3
PW98-03	6797.2	14.1	6783.1
PW98-04	6797.4	12.5	6784.9
PW98-05	6797.3	11.5	6785.8
PW98-06	6797.7	12.3	6785.5
PW98-07	6798.6	14.3	6784.4
PW98-08	6805.3	16.5	6788.8
PW98-09A	6822.7	12	6810.7
PW98-10	6802.3	13.8	6788.5
PW98-11	6801.3	16.4	6784.9
PW98-12	6803.1	18.4	6784.7
PW98-13	6800.5	16.3	6784.2
PW98-14	6799.1	14.5	6784.6
PW98-15	6810.3	10.8	6799.5
PW98-16	6805.7	16.8	6788.9
PW98-17	6801.3	18.5	6782.8
PW98-18	6804.0	21.1	6782.9
PW98-19	6807.5	24.8	6782.7

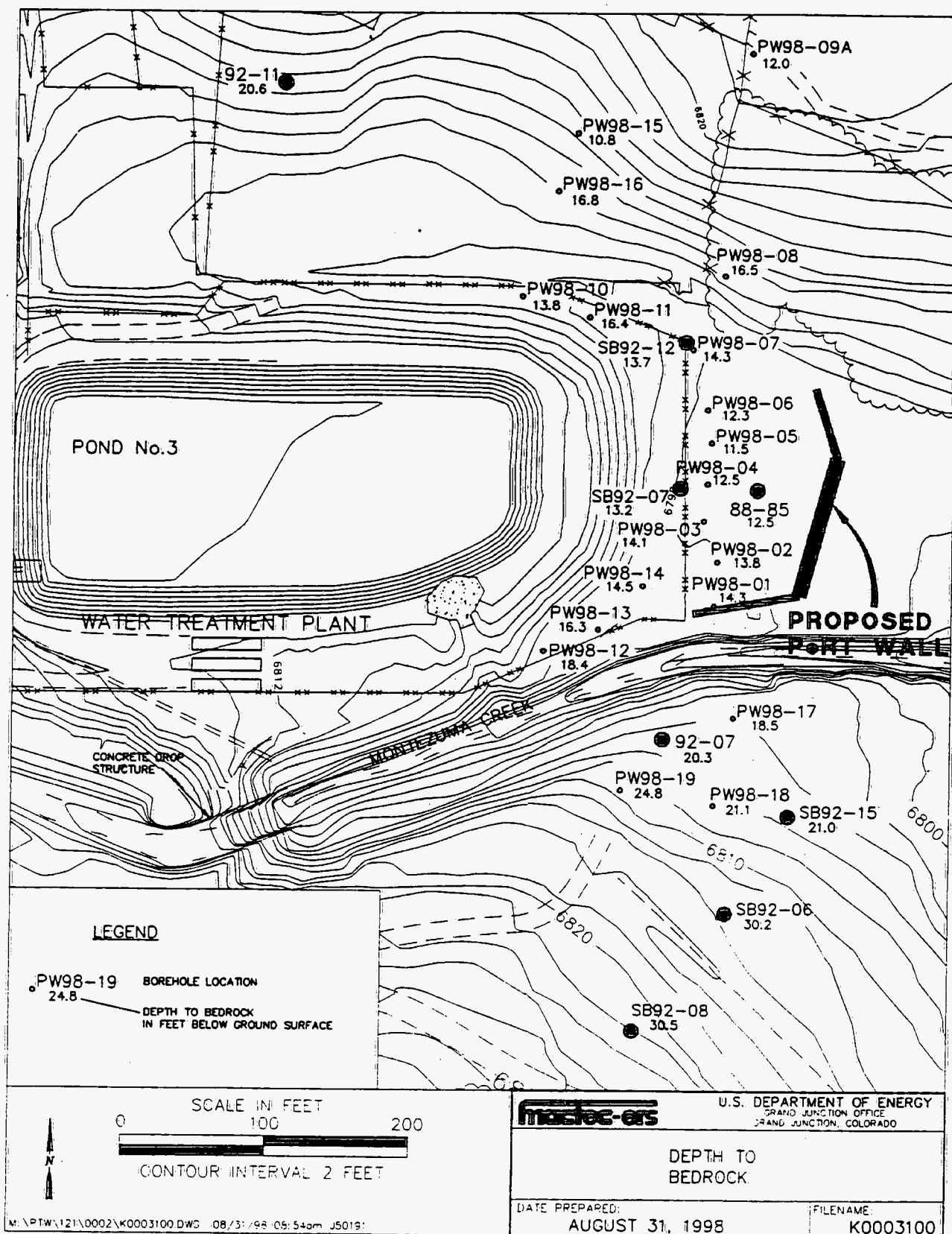


Figure 4.4–1. Depth to Bedrock Below Ground Surface

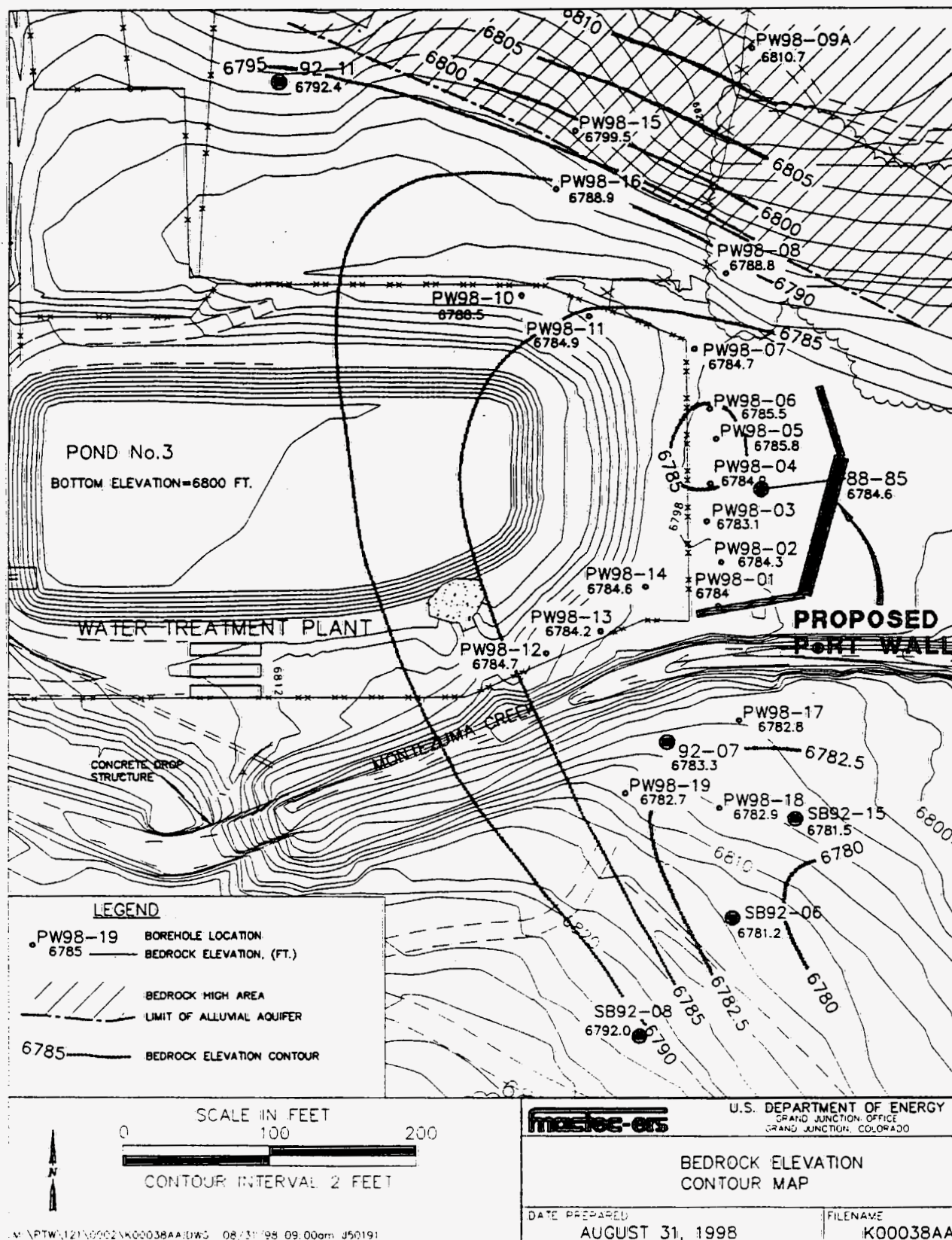


Figure 4.4–2. Bedrock Elevation Contour Map

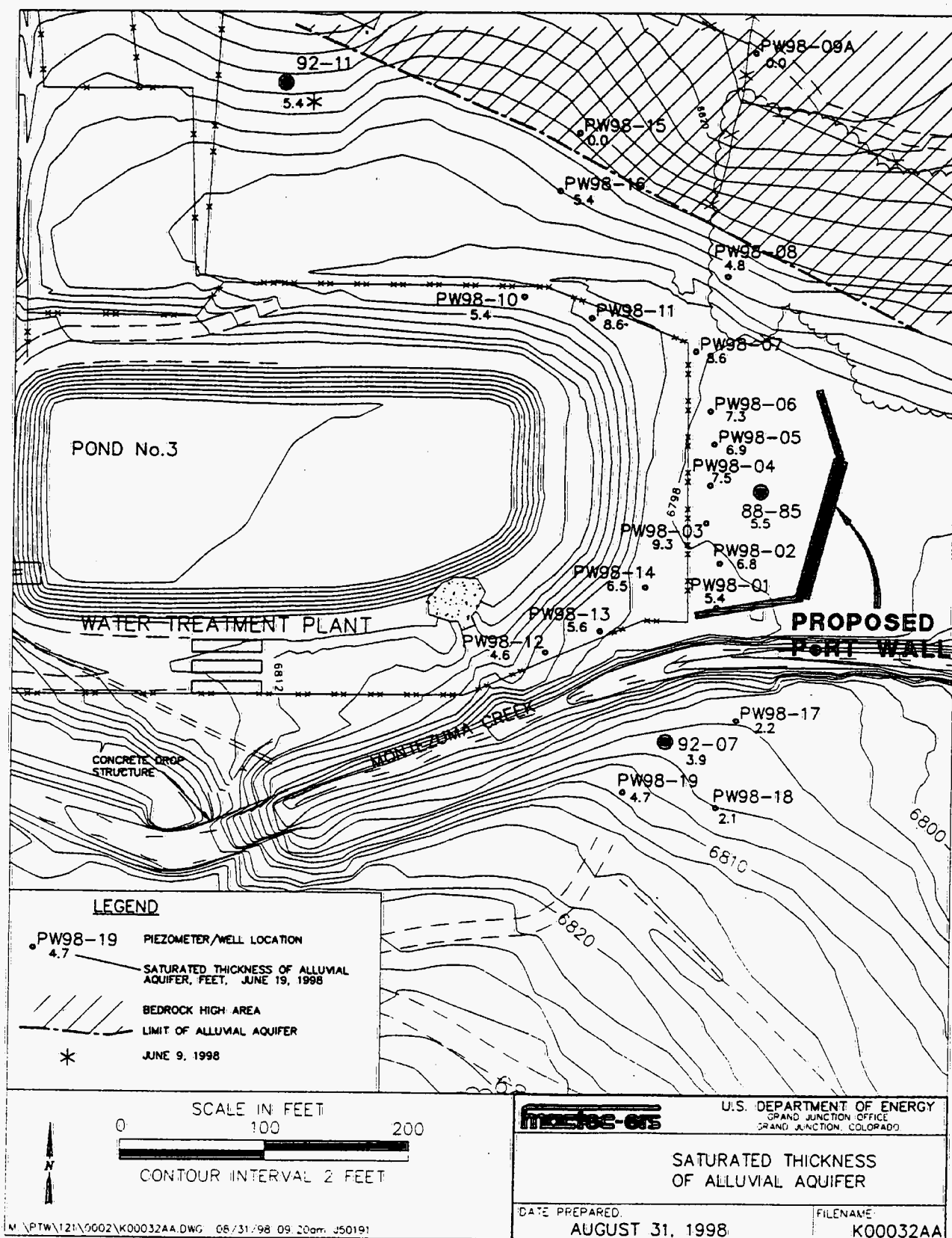


Figure 4.4-3. Saturated Thickness of Alluvial Aquifer, June 19, 1998

Table 4.4-2 Saturated Thickness of Alluvial Aquifer

Borehole	Saturated Thickness [ft]					
	6/9/98	6/19/98	6/24/98	7/16/98	7/22/98	7/29/98
PW98-01	5.5	5.4	5.3	4.9	4.9	4.9
PW98-02	6.8	6.8	6.7	6.2	6.2	6.2
PW98-03	9.5	9.3	9.1	8.5	8.5	8.6
PW98-04	7.7	7.5	7.3	6.8	6.7	6.8
PW98-05	7.1	6.9	6.7	6.1	6.1	6.2
PW98-06	7.5	7.3	7.1	6.5	6.5	6.6
PW98-07	8.7	8.6	8.4	7.8	7.7	7.8
PW98-08	5.1	4.8	4.0	3.3	3.2	3.3
PW98-09A	0	0	0	0	0	0
PW98-10	5.6	5.4	5.2	4.5	4.4	4.5
PW98-11	8.8	8.6	8.4	7.7	7.7	7.7
PW98-12	4.7	4.6	4.4	4.2	4.2	4.3
PW98-13	5.7	5.6	5.5	5.2	5.2	5.2
PW98-14	6.6	6.5	6.4	5.9	5.9	6.0
PW98-15	0	0	0	0	0	0
PW98-16	5.7	5.4	5.2	4.4	4.4	4.5
PW98-17	2.4	2.2	2.1	1.8	1.8	1.9
PW98-18	2.3	2.1	2.0	1.5	1.6	1.8
PW98-19	3.3	4.7	3.5	3.4	3.3	3.4
88-85	5.6	5.5	5.4	5.2	5.0	5.5
92-11	5.4	ND	5.0	ND	4.6	ND
92-07	3.7	3.9	3.8	ND	3.5	3.5

ND = no data

Figure 4.5-1 also indicates that the hydraulic gradient steepens from northwest to southeast. The steepening is not caused by a change in the slope of the bedrock because of the relatively flat bedrock surface in the area. The steepened hydraulic gradient may instead result from a narrowing of the aquifer in the area of the bedrock high, and/or the presence of less transmissive sediments along the north margin of the aquifer, and/or local ground-water mounding around Pond 3.

Figure 4.5-2 presents a north-south sectional view of the integrated subsurface information described in the preceding sections. The elevation of the creek stage and bed, as shown in Figure 4.5-2, were obtained during a previous investigation.

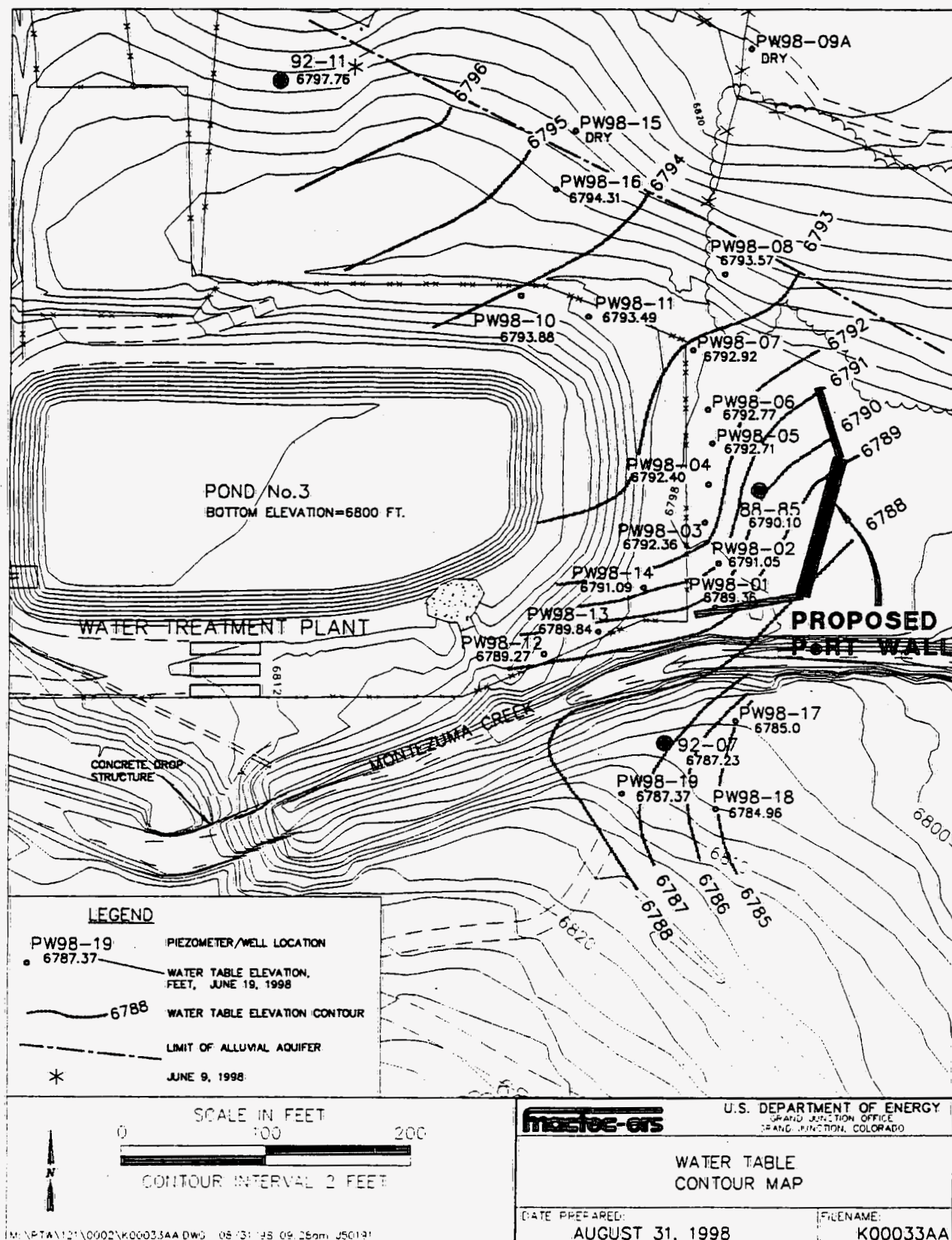


Figure 4.5-1. Alluvial Aquifer Water Table Contour Map, June 19, 1998

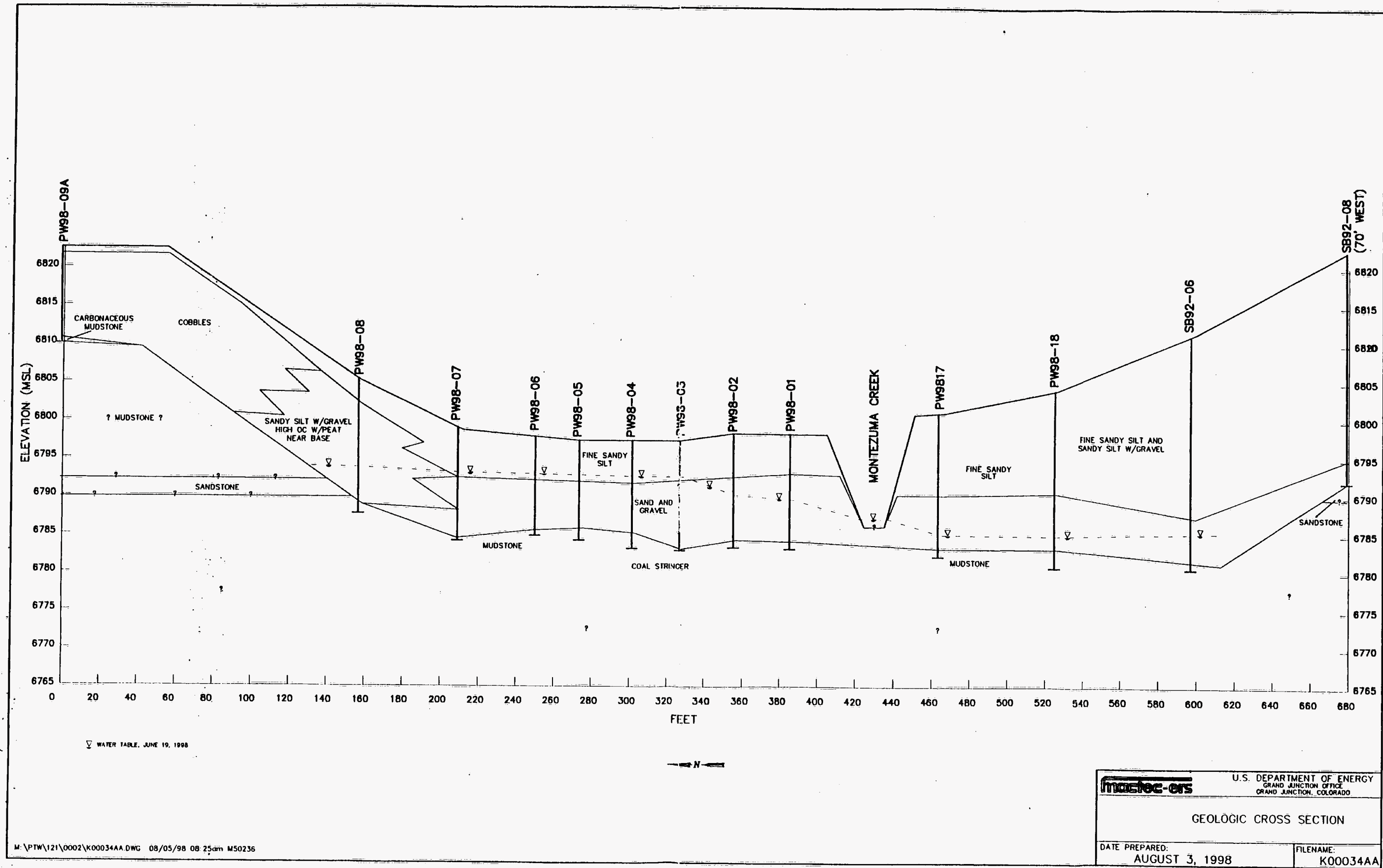


Figure 4.5-2. Geologic Cross Section

4.6 Ground-Water Sampling

A ground-water sample was collected for laboratory analysis from each piezometer on June 9, 1998. Prior to sample collection, piezometers were surged and pumped cyclically to remove fine grained sediments that had accumulated inside the screen during installation. Sample collection was also preceded by purging the piezometer for about 15 to 20 minutes at flow rates of 0.5 to 1 liter/min. Field parameters (e.g., pH, temperature, conductivity) were not measured during the purge, however previous sampling conducted at the site indicates that the purge was sufficient to achieve parameter stability. In most cases, a relatively clear, low-turbidity sample was collected. Samples were withdrawn using HDPE tubing and peristaltic pump and collected in 250-mL HDPE containers. All samples were kept in ice baths or refrigerated until analysis.

The ground-water samples were analyzed for uranium at the Grand Junction Office Environmental Sciences Laboratory on June 11, 1998. Prior to analysis, samples were filtered through 0.45 μm membrane filters. Samples were then analyzed by laser induced fluorescence using a Scintrex UA-3 uranium analyzer.

Results of the analyses are summarized in Table 4.6-1 and illustrated in map view in Figure 4.6-1. The map distribution shows that the lowest concentrations were detected in samples collected at PW98-16 and PW98-08 (0.38 and 0.19 mg/L, respectively), which are located along the northern margin of the aquifer. A consistent trend of increasing uranium concentrations is then observed from north to south between locations PW98-08 and PW98-01 on the north side of the creek, and continues south of the creek to locations PW98-17 and 92-07. Farther south, uranium concentrations increase significantly at locations PW98-18 and PW98-19, where the maximum values were detected (3.6 and 4.2 mg/L, respectively). The maximum concentrations (locations PW98-18 and PW98-19) are comparable with those detected in samples collected previously from well 82-36A (2.6 to 4.1 mg/L), which is located 700 ft to the northwest in the southeast portion of the East Tailings Pile near the millsite boundary. In samples collected previously from well 92-11, uranium concentrations ranged between 1.4 and 2.9 mg/L. These results are comparable with concentrations detected at PW98-10, PW98-12, PW98-13, and PW98-14.

The distribution of uranium is interpreted to represent a composite plume consisting of 2 lobes (Figure 4.6-1). The southern extension, which has higher concentrations, may originate directly from the southeast area of the East Tailings Pile, where mill tailings are believed to extend well below the water table. Uranium is subsequently transported from that area in a relatively narrow plume that is oriented northwest to southeast and extends between the drop structure and a line connecting locations 92-07 and PW98-12. Because the creek is not a hydraulic barrier in this area, the lobe extends south of the creek, and is positioned west and south of the proposed PeRT wall. Concentrations of uranium in Montezuma Creek are much too low to account for the increased levels in ground water south of the creek.

The northern lobe generally occupies the area between wells 92-07 and 92-11, and may represent the combined input from other, more distant, source areas elsewhere on the millsite. The axis (most contaminated portion) of the northern lobe also extends in a southeasterly direction to the south and west of the proposed wall location.

Table 4.6-1 Ground-Water Sample Results

Sample Location	Uranium [mg/L]
PW98-01	1.01
PW98-02	0.979
PW98-03	0.841
PW98-04	0.625
PW98-05	0.704
PW98-06	0.574
PW98-07	0.465
PW98-08	0.192
PW98-10	1.09
PW98-11	0.818
PW98-12	1.46
PW98-13	1.70
PW98-14	1.54
PW98-16	0.379
PW98-17	1.25
PW98-18	3.61
PW98-19	4.18

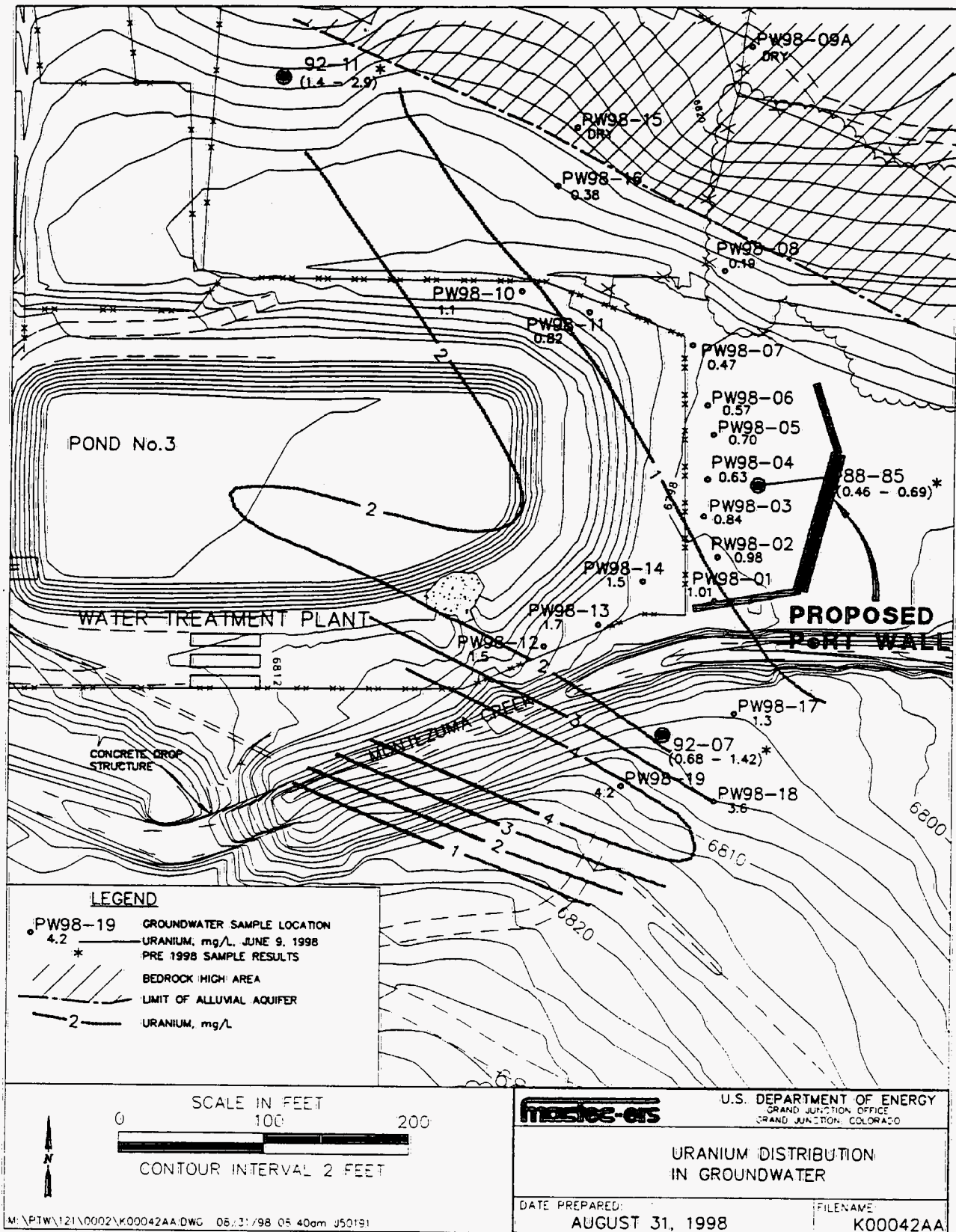


Figure 4.6-1. Uranium Distribution in Ground Water, June 9, 1998

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5.0 Recommendations for Further Characterization

The information presented above provides adequate characterization of the hydrogeology and uranium distribution in ground water north of Montezuma Creek in the PeRT project area. The information indicates that much of the uranium plume may extend farther south than previously anticipated. However, the boundaries of the alluvial aquifer and uranium plume, and ground-water flow in the area south of the creek cannot be determined from the available data. Because such information would benefit the PeRT project, the following tasks are suggested:

- Use the Geoprobe® rig to investigate 5 locations on the south side of Montezuma Creek (south of locations PW98-18 and PW98-19). Proceed south until the limit of the aquifer is encountered. Collect soil and bedrock samples and install temporary piezometer at each location.
- Use the Geoprobe® rig to investigate 3 locations in the vicinity of the water treatment plant on the north side of Montezuma Creek (west of locations PW98-18 and PW98-19). Collect soil and bedrock samples and install temporary piezometer at each location.
- Use the Geoprobe® rig to investigate 2 locations on the south side of the creek near the top of the drop structure. Collect soil and bedrock samples and install temporary piezometer at each location.
- Survey new piezometer locations and elevations.
- Measure depth to ground water at new and existing well and piezometer locations.
- Collect ground-water samples at new and existing well and piezometer locations. Analyze samples for uranium.

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Appendix A

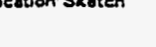
Borehole and Completion Logs, 1998 Field Program

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Project PERT

Location (N) 10254.22 (E) 23954.26

Slot Size #10

<p>Location Sketch</p> 	
---	--

Fluid Level/Date 10.08' 6/19/98 (B50c)

Remarks Abandoned 7/27/98

Verified By

MACTEC-ERS
2597 B 3/4 Road
Grand Junction, Colorado 81502

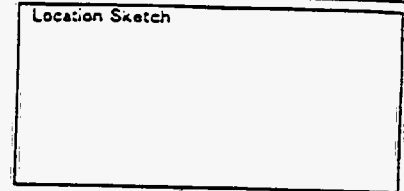
Borehole Summary
Page 1 of 1

Facility N/A Site Monticello Project PERT
Well No. PW 98-02 Location (N) 10287.32 (E) 23954.23

Ground Elev. (Ft.) 6798.1 Bit/Auger Size 2 inch o.d.
Diameter (inch I. D.)

	TYPE	Vol. (cf. gal)	Interval (Ft.)
Blank Casing	PVC	0.5 in	0 to 8.2
Screen	PVC	0.5 in	8.2 to 13.2
Temp/End Cap	PVC	0.5 in	13.2 to 13.3
Sand Pack	10-20 silica		0.5 to 15.5
Sealant	bentonite chips		0 to 0.5
Grout	N/A	N/A	to

Hole Depth (Ft) 15.5
No. of Completions 1
Stick-Up Height (Ft) 0.54
Slot Size #10



Locking Cover Installed Y (N) Padlock No. _____
Drilling Method Geoprobe
Date Drilled 5/28/98 Date Developed N/A
Sampler(s) Bartlett, North, Trevino

Sampling Method 2' core barrel
Fluid Level/Date 7.59' BTOC 6/19/98
Remarks Abandoned 7/27/98

Depth* (FT)	Blows/ 6"	PID ppm	Sample No.; Interval	WELL CONSTRUCTION	GRAPHIC LOG	DESCRIPTION
0						Required Information: Typical name; Munsell color; percentage sand and gravel; sorting (poor to well); grain angularity; induration or plasticity; moisture content (moist to saturated).
2			12-13.5'	Casing Screen Sand Pack		Push w/o sampling to 12'.
4						Sand w/ gravel + cobbles, saturated
6	4/19/98	▽	13.5-15.5'			Recovered ~ 1' 13.5'-13.8' sand + gravel, saturated 13.8-14.5' mudstone, dense, sl.
8						moist, gray.
10						
12						
14					Sand + gravel mudstone	
16			TD			

All depths measured from ground level.

Completed By J. Bartlett Verified By _____

FACTEC-ERS
597 B 3/4 Road
Grand Junction, Colorado 81502

Borehole Summary
Page 1 of 1

City N/A Site Monticello

Project PERT

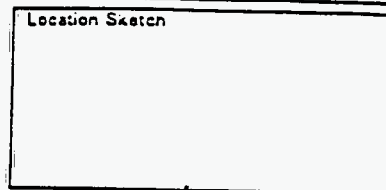
Well No. PW98-03

Location (N) 10315.28 (E) 23946.91

Ground Elev. (Ft.) 6797.2 Bit/Auger Size 2 inch o.d.

Hole Depth (Ft) 16
No. of Completions 1
Stick-Up Height (Ft) 0.36
Slot Size #10

	TYPE	Vol. (cf. gal)	Interval (Ft.)
Link Casing	<u>PVC</u>	<u>0.5 in</u>	<u>0 to 9.6</u>
Screen	<u>PVC</u>	<u>0.5 in</u>	<u>9.6 to 14.6</u>
Temp/End Cap	<u>PVC</u>	<u>0.5 in</u>	<u>14.6 to 14.7</u>
Gravel Pack	<u>10-12 silica</u>		<u>0.5 to 16</u>
Sealant	<u>Bentonite chips</u>		<u>0 to 0.5</u>
Grout	<u>N/A</u>	<u>N/A</u>	<u>— to —</u>



Working Cover Installed Y (N) Padlock No. N/A

Drilling Method Geoprobe

Sampling Method 2' core barrel

Date Drilled 5/28/98 Date Developed N/A

Fluid Level/Date Abandoned 7/27/98

Sampler(s) Bartlett, Worth, Trevino

Remarks ~ 4.8' logs 6/19/98

Depth* (Ft)	Blows/ 6"	PID ppm	Sample No.; Interval	WELL CONSTRUCTION	GRAPHIC LOG	DESCRIPTION
						Required Information: Typical name; Munsell color; percentage sand and gravel; sorting (poor to well); grain angularity; induration or plasticity; moisture content (moist to saturated).
-2						Push to 12' w/o sampling.
-4						
-6						
-8						
-10						
-12						
-14			12-14'	Screen	Sand, gravel, cobbles, coal	Poor recovery: sand w/ gravel and cobbles, saturated.
-16			14-16'		?	Recovered 0.1' coal, dry.
			TD			

*All depths measured from ground level.

Completed By T. Bartlett

Verified By _____

Facility N/A Site Monticello Project PERT

Boring/Well No. PW98-04 Location (N) 10339.84 (E) 23947.84

Ground Elev. (Ft.) 6797.4 Bit/Auger Size 2 inch o.d.
Diameter (inch I. D.)

	TYPE	Vol. (cf. gal)	Interval (Ft.)
Blank Casing	<u>PVC</u>	<u>0.5 in</u>	<u>0 to 6.7</u>
Screen	<u>PVC</u>	<u>0.5 in</u>	<u>6.7 to 11.7</u>
Sump/End Cap	<u>PVC</u>	<u>0.5 in</u>	<u>11.7 to 11.8</u>
Sand Pack	<u>10-20 silica</u>		<u>0.5 to 16</u>
Sealant	<u>benzoinite chips</u>		<u>0 to 0.5</u>
Grout	<u>N/A</u>		<u>to</u>

Hole Depth (Ft) 16
No. of Completions 1
Stick-Up Height (Ft) 0.79
Slot Size #10

Location Sketch

Locking Cover Installed Y (N) Padlock No. N/A

Drilling Method Geoprobe

Date Drilled 5/29/98 Date Developed N/A

Sampler(s) Barlett, Worth, Trevino

Sampling Method 2' core barrel

Fluid Level/Date 5' bgs 6/19/98

Remarks Abandoned 7/22/98

Depth* (FT)	Blows/ 6"	PID ppm	Sample No.: Interval	WELL CONSTRUCTION	GRAPHIC LOG	DESCRIPTION
0						Required Information: Typical name; Munsell color; percentage sand and gravel; sorting (poor to well); grain angularity; induration or plasticity; moisture content (moist to saturated).
2						Pushed w/o sampling to 12'.
4						
6	6/19/98	▽				
8						
10						
12						
14						
16						

All depths measured from ground level.

Completed By T. Bartlett

Verified By _____

Facility N/A Site Monticello Project PERT
Boring/Well No. PH98-05 Location (N) 10368.75 (E) 23948.01

Ground Elev. (Ft.) 6797.3 Bit/Auger Size 2 inch o.d.
Diameter (inch I. D.)

Hole Depth (Ft) 13'
No. of Completions 1
Stick-Up Height (Ft) 0.8
Slot Size #10

	TYPE	Vol. (cf. gal)	Interval (Ft.)
Blank Casing	<u>PVC</u>	<u>0.5 in</u>	<u>0 to 5.8</u>
Screen	<u>PVC</u>	<u>↓</u>	<u>5.8 to 10.8</u>
Cumpr/End Cap	<u>PVC</u>	<u>↓</u>	<u>10.8 to 10.9</u>
Sand Pack	<u>10-20 silica</u>	<u>↓</u>	<u>0.5 to 13</u>
Sealant	<u> Bentonite chips</u>	<u>↓</u>	<u>0 to 0.5</u>
Grout	<u>N/A</u>	<u>↓</u>	<u>to</u>



Locking Cover Installed Y (N) Padlock No. N/A
Drilling Method Geoprobe
Date Drilled 5/29/98 Date Developed N/A
Sampler(s) Bartlett, Worth, Trevino

Sampling Method 2' core barrel
Fluid Level/Date -4.6' hgs 6/19/98
Remarks Abandoned 7/27/98

Depth* (FT)	Blows/ 6"	PID ppm	Sample No.; Interval	WELL CONSTRUCTION	GRAPHIC LOG	DESCRIPTION
0						Required Information: Typical name; Munsell color; percentage sand and gravel; sorting (poor to well); grain angularity; induration or plasticity; moisture content (moist to saturated).
2						Pushed w/o Sampling to ~ 11.5', drillers noted change in push rate @ 11.5'. Attempted sample collection at 11.5': no recovery, cobble in tip.
4	6/11/98	▽	11.5-13.5'	Casing		
6				Sand Pack		- pulled off & moved 2' north. Pushed to 11' & began sampling
8			11-13'	Screen		11-11.5' Saturated sand + gravel
10				Sand Pack		11.5-13 weathered mudstone, soft, moist.
12					Sand + gravel	
14			TD		Mudstone	

* All depths measured from ground level.

Completed By T. Bartlett Verified By _____

Facility N/A Site Monticello

Project PERT

Boring/Well No. PW98-06

Location (N) 10391.19 (E) 23945.01

Ground Elev. (Ft.) 6797.7 Bit/Auger Size 2 inch o.d.
Diameter (inch I. D.)

Hole Depth (Ft.) 14
No. of Completions 1
Stick-Up Height (Ft.) 0.6
Slot Size #10

	TYPE	Vol. (cf. gal)	Interval (Ft.)
Blank Casing	<u>PVC</u>	<u>0.5 in</u>	<u>0 to 8.1</u>
Screen	<u>PVC</u>	<u>↓</u>	<u>8.1 to 13.1</u>
Sump/End Cap	<u>PVC</u>	<u>↓</u>	<u>13.1 to 13.2</u>
Sand Pack	<u>10-20 silica</u>	<u>↓</u>	<u>0.5 to 14</u>
Sealant	<u>Bentonite chips</u>	<u>↓</u>	<u>0 to 0.5</u>
Grout	<u>N/A</u>	<u>↓</u>	<u>to</u>



Locking Cover Installed Y (N) Padlock No. N/A

Drilling Method Geoprobe

Sampling Method 2' core barrel

Date Drilled 5/29/98 Date Developed N/A

Fluid Level/Date 4.9' bgs 6/19/98

Sampler(s) Bartlett, Worth, Trevino

Remarks Abandoned 7/27/98

Depth* (FT)	Blows/ 6"	PID ppm	Sample No.: Interval	WELL CONSTRUCTION	GRAPHIC LOG	DESCRIPTION
0						Required Information: Typical name; Munsell color; percentage sand and gravel; sorting (poor to well); grain angularity; induration or plasticity; moisture content (moist to saturated).
2			10-12'			Pushed to 10' w/o sampling
4						No recovery, drove cobble.
6	6/19/98	▽	12-14'			12-12.25' sand + gravel, saturated.
8						12.25-12.9' gray mudstone w/some fine pyrite nodules.
10						
12						
14			TD			

All depths measured from ground level.

Completed By T. Bartlett Verified By _____

Facility N/A

Site Monticello

Project PERT

Boring/Well No. PW98-07

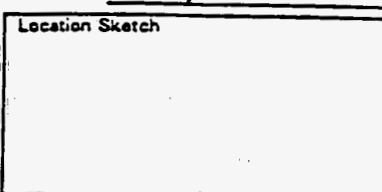
Location (N) 10431.53 (E) 23935.08

Ground Elev. (Ft.) 6798.6 Bit/Auger Size 2 inch o.d.

Hole Depth (Ft) 16

	TYPE	Vol. (cf. gal)	Interval (Ft.)
Link Casing	<u>PVC</u>	<u>0.5 in</u>	<u>0 to 8.4</u>
Screen	<u>↓</u>	<u>↓</u>	<u>8.4 to 13.4</u>
Sump/End Cap	<u>↓</u>	<u>↓</u>	<u>13.4 to 13.5</u>
End Pack	<u>10-20 Silica</u>		<u>0.5 to</u>
Sealant	<u>Bentonite chips</u>		<u>0 to 0.5</u>
Grout	<u>N/A</u>		<u>to</u>

No. of Completions 1
Stick-Up Height (Ft) 1.57
Slot Size #10



Working Cover Installed Y (N) Padlock No. N/A

Logging Method Geoprobe

Sampling Method 2' core barrel

Date Drilled 6/1/98 Date Developed N/A

Fluid Level/Date 5.7' bgs 6/19/98

Sampler(s) Bartlett, Worth, Trevino

Remarks Abandoned 7/27/98

Depth* (FT)	Blows/ 6"	PID ppm	Sample No.; Interval	WELL CONSTRUCTION	GRAPHIC LOG	DESCRIPTION
						Required Information: Typical name; Munsell color; percentage sand and gravel; sorting (poor to well); grain angularity; induration or plasticity; moisture content (moist to saturated).
0						Push to 10' w/o sampling.
2			10-12'			Recovered 3" saturated sand + gravel over 3" silty sand w/ gravel.
4			12-14'			12-12.5' silt/sand/gravel mixture w/ organic carbon/peat fragments.
6	6/19/98	Δ	14-16'			14-14.25' sand + gravel.
8						14.25-14.7' 14.6' clay, wet. Much harder pushing noted ~ 14.5'.
10						
12						
14						
16						
TD						

All depths measured from ground level.

Completed By T. Bartlett

Verified By

Facility N/A Site Monticello Project PERT

Boring/Well No. PW98-08 Location (N) 10485.35 (E) 23956.43

Ground Elev. (Ft.) 6805.3 Bit/Auger Size 2 inch o.d.

	TYPE	Vol. (cf. gal)	Interval (Ft.)	Hole Depth (Ft)	No. of Completions	Stick-Up Height (Ft)	Slot Size
Blank Casing	PVC	0.5 in	0 to 11.7	18	1	0.55	#10
Screen	PVC	0.5 in	11.7 to 16.7				
Jump/End Cap	PVC	0.5 in	16.7 to 16.8				
Land Pack	10-20 Silica		0.5 to 18				
Sealant	Bentonite chips		0 to 0.5				
Grout	N/A		to				



Locking Cover Installed Y (N) Padlock No. N/A
Drilling Method Geoprobe Sampling Method 2' core barrel
Date Drilled 6/2/98 Date Developed N/A Fluid Level/Date 12.28 BTOL 6/19/98
Sampler(s) Bartlett, Worth, Trevino Remarks _____

Depth* (FT)	Blows/ 6"	PID ppm	Sample No.: Interval	WELL CONSTRUCTION	GRAPHIC LOG	DESCRIPTION
0						Required Information: Typical name; Munsell color; percentage sand and gravel; sorting (poor to well); grain angularity; induration or plasticity; moisture content (moist to saturated).
2			8-10'	Sand Pack Casing Sand Pack	Sandy silt w/ gravel + cobbles, intervals w/ high organic carbon	Push to 8' w/o sampling. Hard push 0-6'. V. hard push 6-8'. 8-9.4' Dark sandy silt w/ f. gvl. (Some dioritic) + gobbie fragments (sandstone), dry-sl. moist. High organic carbon + moist ~ 9-9.4'.
4			10-12'			10-10.5' Same as 9-9.4'.
6			12-14'			10.5-10.8' Cobble 10.8-11.3' Sandy silt w/ tr. gvl., moist, organic.
8			14-16'			sandy silt w/ v.f. - f. gvl, moist, cohesive, high organic content, peat parting at ~ 13.9'-14'.
10	6/19/98	▽		Screen	Sand + gravel mudstone	14-14.7' sandy silt w/ gvl. + organic material, moist 14.7-15.3' Sandstone fragments. sand + gvl., wet, betw. 14.7-14.8'.
12						15.3-15.5' clay w/ some gvl., gray, v. moist
14			16-18'			16-16.5' silty sand + gvl., wet, some peat frags. 16.5-18' mudstone, firm, moist, yellow/gray mottling to 16.8, becomes gray + drier.
16						
18			TD			

All depths measured from ground level.

Completed By T. Bartlett Verified By _____

Facility N/A Site Monticello Project Pert
Boring/Well No. PW98-09A Location (N) 10638.78 (E) 23974.43

Ground Elev. (Ft.) 6822.7 Bit/Auger Size 2 inch o.d.

	TYPE	Vol. (cf. gal)	Diameter (inch I. D.)	Interval (Ft.)
Blank Casing	PVC	0.5 in	0 to 6.6	
Screen	PVC	0.5 in	6.6 to 11.6	
Sump/End Cap	PVC	0.5 in	11.6 to 11.7	
Sand Pack	10-20 Silica		0.5 to	
Sealant	bentonite chips		0 to 0.5	
Grout	N/A		to	

Hole Depth (Ft) 12.5
No. of Completions 1
Stick-Up Height (Ft) 0.49
Slot Size #10



Locking Cover Installed Y (N) Padlock No. N/A
Drilling Method Geoprobe Sampling Method 2' core barrel
Date Drilled 6/2/98 Date Developed N/A Fluid Level/Date Dry
Sampler(s) Bartlett, Worth, Trevino Remarks

Depth* (FT)	Blows/ 5"	PID ppm	Sample No.: Interval	WELL CONSTRUCTION	GRAPHIC LOG	DESCRIPTION
0						Required Information: Typical name; Munsell color; percentage sand and gravel; sorting (poor to well); grain angularity; induration or plasticity; moisture content (moist to saturated).
2			5-5.5'	Casing Sand Pack Screen Sand Pack	Cobbles in sandy silty matrix	Pushed w/o sampling to 5'.
4			6-8'			v. difficult push, recovered igneous cobbles fragments, dry.
6			8-10'			igneous cobble fragments, dry. Difficult pushing.
8			10-11'			Igneous + sandstone cobble fragments in sandy/silty matrix. Easier pushing. Dry.
10			11.5-12.5'			No recovery.
12			TD		coal + shale	11.5-12' cobble fragments, dry 12-12.5' coal/carbonaceous mudstone, dry.

* All depths measured from ground level.

Completed By T. Bartlett Verified By

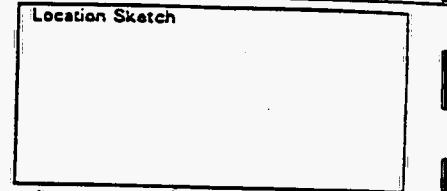
Facility N/A Site Monticello Project PERT

Boring/Well No. PW98-10 Location (N) 10469.83 (E) 23816.40

Ground Elev. (Ft.) 6802.3 Bit/Auger Size 2 inch o.d. Hole Depth (Ft.) 16'

	TYPE	Vol. (cf. gal)	Diameter (inch I. D.)	Interval (Ft.)
Blank Casing	PVC	0.5 in	0 to 8.3	
Screen	PVC	0.5 in	8.3 to 13.3	
Jump/End Cap	PVC	0.5 in	13.3 to 13.4	
Sand Pack	10-20 Silica		0.5 to 16	
Sealant	Bentonite chips		0 to 0.5	
Grout	N/A			

No. of Completions 1
Stick-Up Height (Ft.) 1.69
Slot Size #10



Locking Cover Installed Y (N) Padlock No. N/A
Drilling Method Geoprobe Sampling Method 2' core barrel
Date Drilled 6/2/98 Date Developed N/A Fluid Level/Date 10-11 BTCL 6/19/98
Sampler(s) Bartlett/Worth/Trevino Remarks

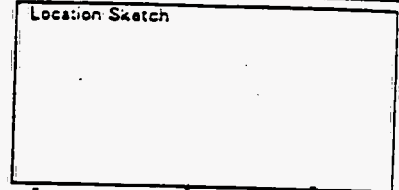
Depth* (FT)	Blows/ 6"	PID ppm	Sample No.: Interval	WELL CONSTRUCTION	GRAPHIC LOG	DESCRIPTION
0						Required Information: Typical name; Munsell color; percentage sand and gravel; sorting (poor to well); grain angularity; induration or plasticity; moisture content (moist to saturated).
2			4-6'			Push w/o sampling to 4', v. easy push
4			6-8'			Fine sandy silt, moist, cohesive, red/brn. same as 4-6'.
6			8-10'			Same to 9.5'. v. easy push to ~9.5'
8			10-12'			9.5'-10' sand + gravel, some fines, saturated.
10			12-14'			Sand/gravel, drove cobble, saturated.
12			14-16'			Sand + gravel to 13.8', saturated.
14						13.8-14' clay/weathered mudstone, yellow + gray mottled.
16						gray mudstone, moist

All depths measured from ground level.
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Facility N/A Site Monticello Project PERT
Boring/Well No. PW98-11 Location (N) 10453.82 (E) 23864.19

Ground Elev. (Ft.) 6801.3 Bit/Auger Size 2 inch o.d.
Diameter (inch I. D.)
TYPE Vol. (cf. gal) Interval (Ft.)
Blank Casing PVC 0.5 in 0 to 9.4
Screen PVC 0.5 in 9.4 to 14.4
Sump/End Cap PVC 0.5 in 14.4 to 14.5
Sand Pack 10-20 silica 0.5 to 17
Sealant bentonite chips 0 to 0.5
Grout N/A to

Hole Depth (Ft.) 17
No. of Completions 1
Stick-Up Height (Ft.) 1.13
Slot Size #10



Locking Cover Installed Y (N) Padlock No. N/A
Drilling Method Geoprobe
Date Drilled 6/2/98 Date Developed N/A
Sampler(s) Bartlett/Worth/Trevino

Sampling Method 2' core barrel
Fluid Level/Date 7.8' bgs 6/19/98
Remarks

Depth* (FT)	Blows/ 6"	PID ppm	Sample No.: Interval	WELL CONSTRUCTION	GRAPHIC LOG	DESCRIPTION
0						Required Information: Typical name; Munsell color; percentage sand and gravel; sorting (poor to well); grain angularity; induration or plasticity; moisture content (moist to saturated).
2			8-10'			Push to 8' w/o sampling, easy push.
4			10-12'			8-8.4' sandy silt, soft, moist. 8.4-8.8' f.-c. sand w/ gravel, saturated.
6			12-14'			Igneous + sandstone cobble fragments, saturated, 0.5' recovery.
8	6/19/98	▽	14-15'			12-12.8' c. sand w/ gravel + cobbles, saturated (0.8' recovery).
10			15-17'			Drive cobble, weathered sandstone frag. in tip.
12						15-16.3' sand + gravel, yellowish, saturated.
14						16.3-16.5' clay, yellow, soft, wet
16						16.5-17' clay, soft, moist, gray w/ olive mottling.
18			TD			mudstone

* All depths measured from ground level.

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Facility N/A Site Monticello Project PERT

Boring/Well No. PW98-12 Location (N) 10223.02 (E) 23837.14

Ground Elev. (Ft.) 6803.1 Bit/Auger Size 2 inch o.d.

	TYPE	Vol. (cf. gal)	Interval (Ft.)	Hole Depth (Ft)	No. of Completions	Stick-Up Height (Ft)	Slot Size
Blank Casing	PVC	0.5 in	0 to ~14	20	1	1.04	#10
Screen	PVC	0.5 in	14 to 19				
Jump/End Cap	PVC	0.5 in	19 to 19.1				
Sand Pack	10-20 Silica		0.5 to 20				
Sealant	bentonite chips		0 to 0.5				
Grout	N/A		to				

Locking Cover Installed Y (N) Padlock No. N/A
Drilling Method Geoprobe Sampling Method 2' core barrel
Date Drilled 6/3/98 Date Developed N/A Fluid Level/Date 14.87 BTA 6/19/98
Sampler(s) Bartlett/Worth/Trevino Remarks

Depth* (FT)	Blows/ 6"	PID ppm	Sample No.; Interval	WELL CONSTRUCTION	GRAPHIC LOG	DESCRIPTION
0						Required Information: Typical name; Munsell color; percentage sand and gravel; sorting (poor to well); grain angularity; induration or plasticity; moisture content (moist to saturated).
2			6-8' 8-10'			Push to 6' w/o sampling. V. easy push. Sandy silt, sl. moist, v. easy push. 8-9' Same
4			10-12'			9-9.5' Sand w/ gvl. 9.5-10' Sand + silt, moist, easy push. Sand + silt, moist, easy push.
6			12-14'			12-13' Same. 13-14' Sand w/ gvl. + silt, wet @ 13.5'
8			14-16'			Sand/gvl./silt, some cobbles, wet to saturated at ~15'
10			16-18'	Sand Pack	Casing	Cobble at 16' then sand + f. - c. gvl., some fines, saturated.
12			18-20'	Sand Pack		
14	6/11/98	▽		Screen		Sand + gravel to 18.4' 18.4' - 19.4' clay, yellow + gray, moist, soft, grades to gray clay, sl. moist.
16						
18						
20			TD			

All depths measured from ground level.

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Facility N/A Site Mantiello Project PERT
Boring/Well No. PW98-13 Location (N) 10239.13 (E) 23874.66

Ground Elev. (Ft.) 6800.5 Bit/Auger Size 2 inch o.d.

Diameter (inch I. D.)

	TYPE	Vol. (cf. gal)	Interval (Ft.)
Blank Casing	<u>PVC</u>	<u>0.5 in</u>	<u>0 to 10.2</u>
Screen	<u>PVC</u>	<u>0.5 in</u>	<u>10.2 to 15.2</u>
Sump/End Cap	<u>PVC</u>	<u>0.5 in</u>	<u>15.2 to 15.3</u>
Sand Pack	<u>10-20 silica</u>		<u>0.5 to 17</u>
Sealant	<u>bentonite chips</u>		<u>0 to 0.5</u>
Grout	<u>N/A</u>		<u>to</u>

Hole Depth (Ft) 17
No. of Completions 1
Stick-Up Height (Ft) 0.86
Slot Size #10

Location Sketch

Locking Cover Installed Y (N) Padlock No. N/A

Drilling Method Geoprobe

Sampling Method 2' core barrel

Date Drilled 6/3/98 Date Developed N/A

Fluid Level/Date 10.7' bgs 6/19/98

Sampler(s) Bartlett / Worth / Trevino

Remarks

Depth* (FT)	Blows/ 6"	PID ppm	Sample No.; Interval	WELL CONSTRUCTION	GRAPHIC LOG	DESCRIPTION
0						Required Information: Typical name; Munsell color; percentage sand and gravel; sorting (poor to well); grain angularity; induration or plasticity; moisture content (moist to saturated).
2			10-12'			Push w/o sampling to 10'. Easy push to 9', resistance increases some at 9'.
4			12-14'			Sand w/ gravel and cobbles. Saturated at ~ 11.5'
6			15-17'			Sand w/ gravel and cobbles.
8						15-16.3' Sand and gravel with cobbles, some fines.
10						16.3-17' clay, firm, moist.
12						
14						
16						
18						

* All depths measured from ground level.

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Facility N/A Site Monticello Project PERT

Boring/Well No. PW98-14 Location (N) 10269.20 (E) 23904.94

Ground Elev. (Ft.) 6799.1 Bit/Auger Size 2 inch o.d. Hole Depth (Ft.) 16' 15.5"
Diameter (inch I. D.)

	TYPE	Vol. (cf. gal)	Interval (Ft.)
Blank Casing	<u>PVC</u>	<u>0.5 in</u>	<u>0 to 8.5</u>
Screen	<u>PVC</u>	<u>0.5 in</u>	<u>8.5 to 13.5</u>
Sump/End Cap	<u>PVC</u>	<u>0.5 in</u>	<u>13.5 to 13.6</u>
Sand Pack	<u>10-20 Silica</u>		<u>0.5 to 16' 15.5"</u>
Sealant	<u>Bentonite chips</u>		<u>0 to 0.5</u>
Grout	<u>N/A</u>		<u>to</u>

No. of Completions 1
Stick-Up Height (Ft.) 1.51
Slot Size #10

Locking Cover Installed Y Padlock No. N/A
Drilling Method Geoprobe Sampling Method 2' core barrel
Date Drilled 6/3/98 Date Developed N/A Fluid Level/Date 9.52 BTOL 6/19/98
Sampler(s) Bartlett/Worth/Trevino Remarks

Depth* (FT)	Blows/ 6"	PID ppm	Sample No.: Interval	WELL CONSTRUCTION	GRAPHIC LOG	DESCRIPTION
0						Required Information: Typical name; Munsell color; percentage sand and gravel; sorting (poor to well); grain angularity; induration or plasticity; moisture content (moist to saturated).
2			12-14'	Sand Pack Casing Screen Sand Pack	fine sandy silt	Push to 12' w/o Sampling
4			14-15.5'			sand/gravel w/ cobbles, saturated
6			14-16'			1.4' recovery 14-14.5' clean sand w/ gvl., saturated
8	6/19/98	▽				14.5'-15.5' clay/weathered mudstone soft, wet, mottled yellow + gray
10						
12						
14						
16			TD		mudstone	

All depths measured from ground level.

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Facility N/A

Site Monticello

Project PERT

Boring/Well No. PW98-15

Location (N) 10582.83 (E) 23855.55

Ground Elev. (Ft.) 6810.3

Bit/Auger Size 2 inch o.d.

Hole Depth (Ft.) 14'

Diameter (inch I. D.)

No. of Completions 1

TYPE

Vol. (cf. gal)

Interval (Ft.)

Stick-Up Height (Ft)

Link Casing

PVC

0.5 in

0 to 10.8 5.8

0.57

Screen

PVC

0.5 in

5.8 to 10.8

Grout/End Cap

PVC

0.5 in

10.8 to ~10.9

Grout Pack 10-20 to Silica

0.5 to 14

0.5 to 14

Grout

Bentonite chips

0 to 0.5

0 to 0.5

Grout

N/A

N/A

N/A

Working Cover Installed Y (N)

Padlock No. N/A

Logging Method Geoprobe

Sampling Method 2' core barrel

Date Drilled 6/3-6/4/98

Date Developed N/A

Fluid Level/Date dry 6/19/98

Sampler(s) Bartlett / North / Trevino

Remarks

Depth* (FT)	Blows/ 6"	PID ppm	Sample No.; Interval	WELL CONSTRUCTION	GRAPHIC LOG	DESCRIPTION
						Required Information: Typical name; Munsell color; percentage sand and gravel; sorting (poor to well); grain angularity; induration or plasticity; moisture content (moist to saturated).
0						Attempted sampling to 3'. No recovery, v. hard pushing/sampling due to cobbles.
2						Pushed to 6' w/o sampling, cobbly to ~5' then easier push 5-6'.
4						0-5' sandy silt and cobbles, dry.
6						5-6' Sandy silt
8			6-8'			Dark silt w/ f-m sand, some gvl., dry.
10			8-10'			8-8.3' Sandy silt w/ some gvl., dry.
12			10-12'			8.3-10' black organic silt/peat, some sand, rootlets, dry, w/ some gvl. 9.8-10'.
14			12-14'			10-10.5' Sandstone fragments (cobble?)
						10.5-10.8' black organic silt/peat, some gvl., rootlets, dry.
						10.8-12' clay, firm, dry, mottled white + gray.
						Gray mudstone, dry, w/ carbonaceous intervals.

All depths measured from ground level.

Completed By T. Bartlett

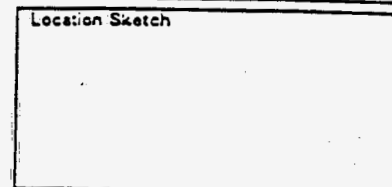
Verified By

Facility N/A Site Monticello Project PERT
Boring/Well No. PW 98-16 Location (N) 10541.67 (E) 23841.38

Ground Elev. (Ft.) 6805.7 Bit/Auger Size 2 inch o.d.
Diameter (inch I. D.)

Hole Depth (Ft) 20
No. of Completions 1
Stick-Up Height (Ft) 1.11
Slot Size #10

	TYPE	Vol. (cf. gal)	Interval (Ft.)
Blank Casing	<u>PVC</u>	<u>0.5 in</u>	<u>0 to 10.3</u>
Screen	<u>PVC</u>	<u>0.5 in</u>	<u>10.3 to 15.3</u>
Sump/End Cap	<u>PVC</u>	<u>0.5 in</u>	<u>15.3 to 15.4</u>
Sand Pack	<u>10-20 Silica</u>		<u>0.5 to 20</u>
Sealant	<u>bentonite chips</u>		<u>0 to 0.5</u>
Grout	<u>N/A</u>		<u>to</u>



Locking Cover Installed Y (N) Padlock No. N/A

Drilling Method Geo probe

Sampling Method 2' core barrel

Date Drilled 6/4/98 Date Developed N/A

Fluid Level/Date 11.4' lgs 6/19/98

Sampler(s) Bartlett/Worth/Trevino

Remarks

Depth* (FT)	Blows/ 6"	PID ppm	Sample No.: Interval	WELL CONSTRUCTION	GRAPHIC LOG	DESCRIPTION
0						Required Information: Typical name; Munsell color; percentage sand and gravel; sorting (poor to well); grain angularity; induration or plasticity; moisture content (moist to saturated).
2			2-4'			Push to 2' w/o sampling.
4			4-6'			Sandy silt w/ some gravel, dry, dark brn.
6			6-8'			Sandy silt, trace gravel, moist, soft, v. easy push.
8			8-10'			Same as 4-6'.
10			10-12'			Same as 4-6'.
12			12-14'			Sand + gravel w/ cobbles, saturated.
14			14-16'			Same as 12-14'.
16			16-18'			16-16.8' gravelly sand, some cobbles + fines.
18			18-20'			16.8-17.5' clay, soft, wet.
20						Clay, gray, moist, firm.

* All depths measured from ground level.

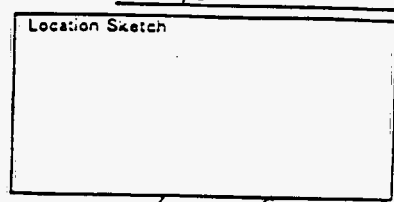
Completed By T. Bartlett Verified By

City N/A Site Monticello Project PERT

Well No. FW 98-17 Location (N) 10178.12 (E) 23965.47

Ground Elev. (Ft.) 6801.3 Bit/Auger Size 2 inch o.d.
 TOC 6801.42 Diameter (inch I. D.)
 TYPE Vol. (cf. gal) Interval (Ft.)
 Casing PVC 0.5" 0 to 13.4
 Screen PVC 0.5" 13.4 to 18.4
 Plug/End Cap PVC 0.5" 18.4 to 19.5
 Mud Pack 10-20 20-40 Silica 0.5 to 19.5
 Sealant Bentonite chips 0 to 0.5
 Grout N/A to

Hole Depth (Ft) 19.5
 No. of Completions 1
 Stick-Up Height (Ft) 0.12
 Slot Size #10



Working Cover Installed Y Padlock No. N/A
 Drilling Method 6/8/98 Geoprobe Sampling Method 2' core barrel
 Date Drilled 6/8/98 Date Developed N/A Fluid Level/Date 16.42 BTOC 6/19/98
 Sampler(s) Bartlett / North / Trevino Remarks South of creek in line

Depth* (Ft)	Blows/ 6"	PID ppm	Sample No.: Interval	WELL CONSTRUCTION	GRAPHIC LOG	DESCRIPTION
						W/ FW 98-21
						Required Information: Typical name; Munsell color; percentage sand and gravel; sorting (poor to well); grain angularity; induration or plasticity; moisture content (moist to saturated).
-2						Easy uniform push to 8' sandy silt, red
-4						8-10' easy push, sample collected
-6						Sandy silt red, moist; wet at ~9.5-10'
-8						10-12' Harder pushing @ 11' (gravel)
-10						10-11' red sandy silt moist wet silt
-12						11-12' silty + c sand of gal + cobbles, moist-w
-14						12-14' recovered 1' of dry cobbles frags + c.
-16						Sandy gal
-18						14-16' recovered 0.8' of dry cobbles gal w/
-20						Sand ss + discrete cobbles fragments.
						Matrix is moist.
						16-18 1.5' recovery 16-17' sandy gal/cobbles
						moist. 17-18 same; saturated.
						18-18.5 saturated s + g.
						18.5-19.5 Weathered shale
						yellow olive grades to gray w/ depth.
						wet-silt 18.5 to 19.
						firm sl. moist 19-19.5. crumbles.
						BGS set @ 18.5'

* depths measured from ground level.

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Facility N/A Site Monticello Project PERT

Boring/Well No. PW 98-18 Location (N) 10118.72 (E) 23953.77

Ground Elev. (Ft.) 6804 Bit/Auger Size 2 inch o.d.

Hole Depth (Ft.) 23.5
Diameter (inch I. D.)
No. of Completions 1
Stick-Up Height (Ft.) -0.06
Slot Size #10

	TYPE	Vol. (cf. gal)	Interval (Ft.)
Blank Casing	<u>0.5 in PVC</u>		<u>0</u> to <u>15.5</u>
Screen	<u>PVC</u>		<u>15.5</u> to <u>20.5</u>
Plug/End Cap	<u>PVC</u>		<u>20.5</u> to <u>20.6</u>
Sand Pack	<u>10-20 20/40 Silica Sand</u>		<u>0.5</u> to <u>20.6</u>
Sealant	<u>Bent, chips</u>		<u>0</u> to <u>0.5</u>
Grout	<u>N/A</u>		<u>to</u>

Locking Cover Installed Y (N) Padlock No. N/A

Drilling Method Geoprobe

Date Drilled 6/8/98 Date Developed N/A

Sampler(s) Bartlett / North / Trevino

Sampling Method 2ft core barrel

Fluid Level/Date ~ 45' South of PW 98-17

Remarks 18.8' BTCL 6/19/98

Depth* (FT)	Blows/ 6"	PID ppm	Sample No.: Interval	WELL CONSTRUCTION	GRAPHIC LOG	DESCRIPTION
0						Required Information: Typical name; Munsell color; percentage sand and gravel; sorting (poor to well); grain angularity; induration or plasticity; moisture content (moist to saturated).
			0-10'			Direct push to 10' w/o sampling. Easy push (Sandy silt)
			10-12'			2' recovery/ dark red/brown sandy silt, moist/v. moist, soft, easy push.
5			12-14'			Sandy silt, soft, moist to 13'.
			14-16'			13-13.5' silty sand w/ gravel f-a.
			16-18'			13.5-14' Sandy silt, v. moist/wet, soft.
10			18-20'			Sandy silt v. moist/soft, easy push.
			20-22'			Recovered 1' of silty sand w/ some f. gravel, moist, soft (Qm)
						No recovery. Easy push
15						20-20.5' silty sand + gravel, wet
						20.5-21' sand/gravel/cobbles, some fines, saturated
						21-21.3 Clay/Weathered mudstone, yellow, soft, wet.
			22-23.5'			22-22.2 clay, soft, yellow/gray, moist
20						22.2-23.5 Mudstone/shale, gray, dry, firmer.
25						

All depths measured from ground level.

Completed By T. Bartlett Verified By _____

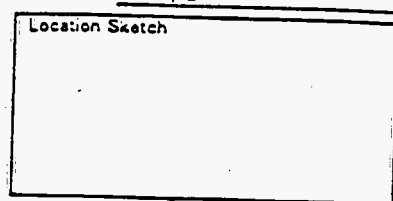
Facility N/A Site Monticello Project PERT

Boring/Well No. PW98-19 Location (N) 10125.03 (E) 23889.96

Ground Elev. (Ft.) 6807.5 Bit/Auger Size 2 inch o.d.

	TYPE	Vol. (cf. gal)	Interval (Ft.)
Blank Casing	<u>PVC</u>	<u>0.5 in</u>	<u>0</u> to <u>19.5</u>
Screen	<u>PVC</u>	<u>↓</u>	<u>19.5</u> to <u>24.5</u>
Sump/End Cap	<u>PVC</u>	<u>↓</u>	<u>24.5</u> to <u>24.6</u>
Sand Pack	<u>10-20 silica</u>	<u>↓</u>	<u>0.5</u> to <u>0</u>
Sealant	<u>Bentonite chips</u>	<u>↓</u>	<u>0</u> to <u>0.5</u>
Grout	<u>N/A</u>	<u>↓</u>	<u>0</u> to <u>0</u>

Hole Depth (Ft) 25
 No. of Completions 1
 Stick-Up Height (Ft) 0.01
 Slot Size #10



Locking Cover Installed Y (N) Padlock No. N/A
 Drilling Method Geoprobe Sampling Method 2' core barrel
 Date Drilled 6/19/98 Date Developed N/A Fluid Level/Date 20.1' bgs 6/19/98
 Sampler(s) Bartlett/Worth/Trevino Remarks

Depth* (FT)	Blows/ 6"	PID ppm	Sample No.; Interval	WELL CONSTRUCTION	GRAPHIC LOG	DESCRIPTION
0						Required Information: Typical name; Munsell color; percentage sand and gravel; sorting (poor to well); grain angularity; induration or plasticity; moisture content (moist to saturated).
2.5			20-22'			Push to 20' w/o sampling.
5			22-24'			Sandy silt, some gravel (qtz?)
7.5			24-26'			Sand w/ gravel + cobbles, saturated.
10						24 - 24.8' Sand/gravel/cobbles.
12.5						24.8 - 25' Clay, soft, wet.
15						
17.5						
20	6/19/98	▽				
22.5						
25						

* All depths measured from ground level.

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Appendix B

Borehole and Completion Logs, 1992 Field Program

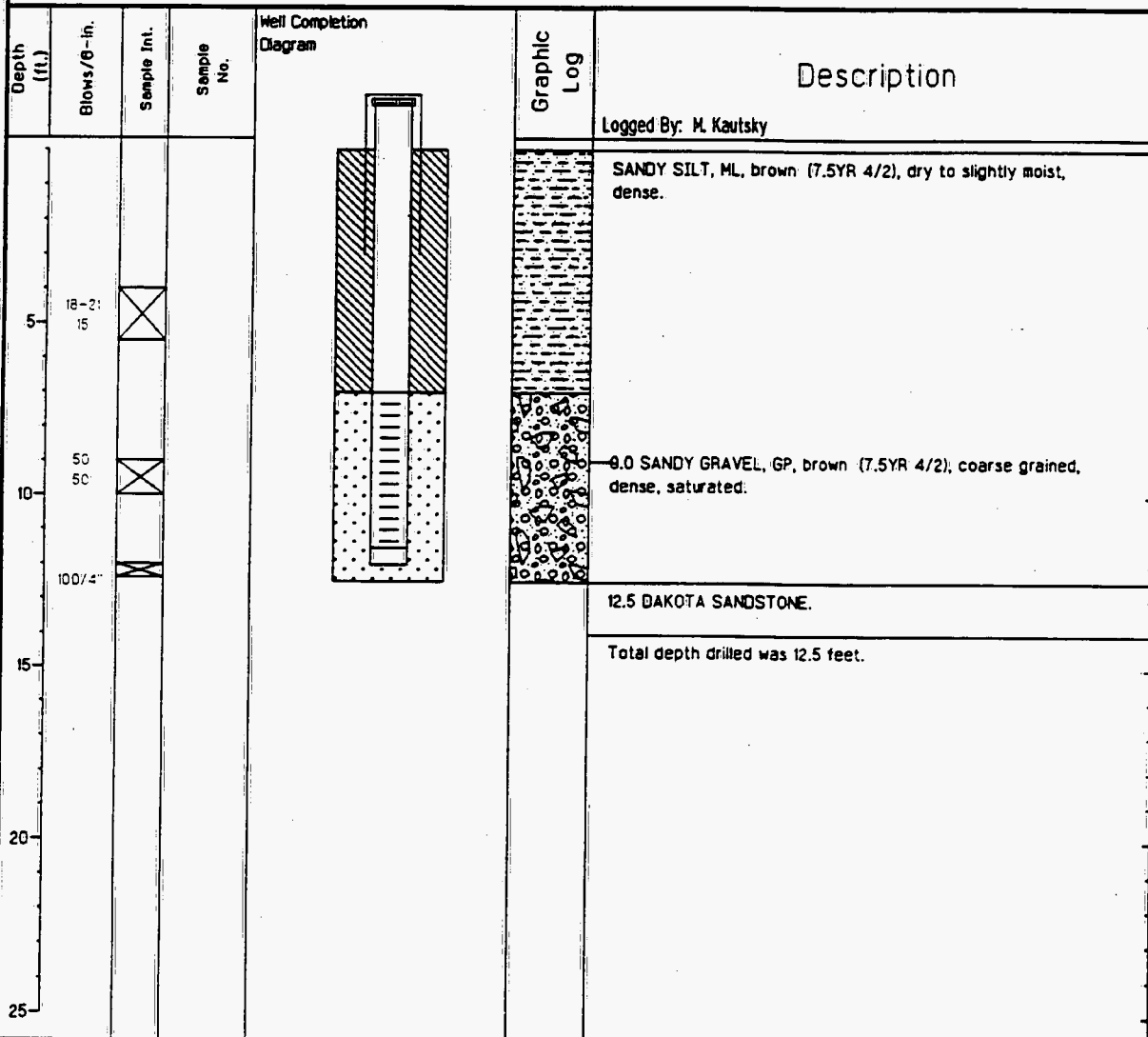
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MONITORING WELL COMPLETION LOG 88-85

Project: Monticello Mill Tailings Site	North Coordinate (ft.): 10,336.2	Date Drilled: 09/30/88
Location: Monticello, Utah	East Coordinate (ft.): 23,982.7	Drilling Method: Hollow-Stem Auger
Site: Downgradient, just east of East Tailings Pile	Ground Elevation (ft. MSL): 6797.1	Sampling Method: Split Barrel
Total Depth (ft.): 12.5	Measuring Point Elev. (ft.): 6797.6	Development Date: Unknown
Auger Stem Size (in.): Unknown	Auger Head Size (in.): Unknown	Water Level (ft. BGL): Unknown

WELL INSTALLATION		INTERVAL (ft.)	BIT SIZES (in.)
Blank Casing:	2.0 in. SCH 40 PVC	+0.5 to 6.5	Not Applicable
Screen:	2.0 in. SCH 40 PVC	6.5 to 11.5	
Slot Size:	0.02 in.		
End Cap:	2.0 in. SCH 40 PVC	11.5 to 12.0	SURFACE CASING (ft.)
Grout:	Unknown	0.0 to 6.5	Protective Steel from +1.6 to 1.0
Sealant:	NA		
Sand Pack (U):	Unknown	6.5 to 12.5	
Sand Pack (L):	NA		

Comments: Locking cap.



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File: 8885.LOG

Date Drawn: 03/02/1994

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MONITORING WELL COMPLETION LOG 92-07

Project: Monticello Mill Tailings Site	North Coordinate (ft.): 10,162.3	Date Drilled: 10/02/92
Location: Monticello, Utah	East Coordinate (ft.): 23,918.2	Drilling Method: Hollow-Stem Auger
Site: Downgradient, just east of East Tailings Pile	Ground Elevation (ft. MSL): 6803.6	Sampling Method: Split Barrel, 3.0 in. X 24 in.
Total Depth (ft.): 21.33	Measuring Point Elev. (ft.): 6805.85	Development Date: 10/17/92
Auger Stem Size (in.): 4.5 ID X 7.625 OD	Auger Head Size (in.): 8.0	Water Level (ft. BGL): 16.86, 10/18/92

WELL INSTALLATION	INTERVAL (ft.)	BIT SIZES (in.)
Blank Casing: 2.0 in. Trilok Sch 40 PVC	+2.25 to 15.3	Not Applicable
Screen: 2.0 in. Trilok Sch 40 PVC	15.3 to 20.3	
Slot Size: 0.010 in.		
End Cap: 2.0 in. Trilok Sch 40 PVC	20.3 to 20.7	SURFACE CASING (ft.)
Grout: Enviroplug	2.0 to 9.5	4.0 in. Protective Steel from +2.57 to 2.43
Sealant: 1/4 in. Enviroplug Pellets	9.5 to 12.6	Cement Pad from +0.37 to 2.0
Sand Pack (U): #20-40 Silica Sand	12.6 to 13.0	
Sand Pack (L): #10-20 Silica Sand	13.0 to 21.3	Comments: CME-75 Drill Rig

Depth (ft.)	Blows/ft.-in.	Sample Int.	Sample No.	Well Completion Diagram	Graphic Log	Description
						Logged By: D. Traub
5/6			soil			SANDY SILT/SILTY SAND, dark brown (7.5YR 4/3), dry, stiff, roots throughout, moderate HCL reaction.
7/9			samples			2.0 Not as stiff as above, firm, 5% caliche on fractures, strong reaction to HCL, dry.
7/11			not			
13/12			saved			
9/10						5.0 Same as above, dark brown (7.5YR 4/3).
9/9						8.0 Dark brown (7.5YR 3/2), stiff, 2% caliche, 1% black oxidized organic material to 1/4 in., slightly moist.
7/8						Little caliche below 9.0 feet, moderate HCL reaction down to 9.8 feet then no HCL reaction, moist at 9.8 feet.
9/11						10.0 SILTY SAND/SANDY SILT, dark brown, very fine-grained sand, no caliche.
7/6						11.1 SANDY/SILTY GRAVEL, dark brown (7.5YR 4/4), subrounded to subangular, igneous pebbles to 1 in., very silty at 11.9 feet.
6/6						12.0 SILTY SAND, dark brown (10YR 2/2), very fine-grained, firm, moist, few pebbles to 13.8 feet, then 20% igneous pebbles subrounded, very weathered.
3/5						14.0 SANDY/SILTY GRAVEL, subrounded igneous pebbles to 3 in., very wet at 15.8 feet, but not saturated, 10% fractured cobbles, very silty from 15.7 to 18 feet.
10/10						Sampler refusal at 17.0 feet, saturated at 16.5 feet.
3/5						18.0 SANDY/SILTY GRAVEL, dark brown, fractured igneous pebbles and subrounded igneous pebbles to 1 1/2 in.
8/21						20.3 DAKOTA SANDSTONE, SILTSTONE, dark gray. Sampler refusal at 20.8 feet. Augered to 21.33 feet.
13/13						Total depth drilled was 21.33 feet.
6/10						
18/40						
refusal						
26/23						
50-5"						
32/50-5"						

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File: 9207.log

Date Drawn: 02/04/1994

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MONITORING WELL COMPLETION LOG 92-11

Project: Monticello Mill Tailings Site	North Coordinate (ft.): 10,618.07	Date Drilled: 10/01/92
Location: Monticello, Utah	East Coordinate (ft.): 23,652.29	Drilling Method: Hollow-Stem Auger
Site: Downgradient, just east of East tailings Pile	Ground Elevation (ft. MSL): (6806.5) ~6613	Sampling Method: Split Barrel, 3.0 in. X 24 in.
Total Depth (ft.): 14.2	Measuring Point Elev. (ft.): (6808.93) 6813.73	Development Date: 10/09/92 - 10/20/92
Auger Stem Size (in.): 4.5 ID X 7.625 OD	Auger Head Size (in.): 8.0	Water Level (ft. BGL): 12.33, 10/17/92

WELL INSTALLATION		INTERVAL (ft.)	BIT SIZES (in.)
Blank Casing: 2.0 in. TriLok SCH 40 PVC		+2.43 to 9.53	Not Applicable
Screen: 2.0 in. TriLok SCH 40 PVC		9.53 to 13.88	
Slot Size: 0.010 in.			
End Cap: 2.0 in. TriLok SCH 40 PVC		13.88 to 14.18	
Grout: Cement		0.0 to 4.0	SURFACE CASING (ft.)
Sealant: 1/4 in. Enviroplug Pellets		4.0 to 7.0	4.0 in. Protective Steel from +2.7 to 2.3
Sand Pack (U): #10-20 Silica Sand		7.0 to 14.18	Cement Pad from +0.37 to 4.0
Sand Pack (L): NA			

Comments: CME-75 Drill Rig

Depth (ft.)	Blows/ft.-in.	Sample Int.	Sample No.	Well Completion Diagram	Graphic Log	Description
						Logged By: D. Traub
12/16			soil			SILT, sandy, brown (7.5YR 5/2), dry, no caliche or pebbles, moderate reaction to HCL.
10/14			samples			
2/3			not			2.0 SILT, with very fine-grained sand, stiff, dry, slightly clayey, fine-to medium-grained sand content increasing.
4/8			seved			4.6 SAND, silty, dark brown (7.5YR 4/2).
6/8						6.0 SILT, sandy, dark brown, firm, moist, grades into a silty, medium-grained sand. 10% pebbles to 3/4 in. from 7.8 to 8.0 feet. Minor reaction to HCL throughout.
7/9						
8/12						8.0 GRAVEL, sandy, slightly silty, iron stained, various colors depending on pebble type (igneous or sandstone), fractured igneous and sandstone pebbles to 2 in. with 90% less than 1/4 in. Moist to 8.5 feet, then saturated.
12/14						Fractured, subrounded to subangular, igneous pebbles to 2 in., silty and sandy to 11.0 feet, then little silt from 11.0 to 12.0 feet.
9/20						GRAVEL, sandy, slightly silty, medium-to coarse-grained, slightly silty, subrounded to subangular igneous pebbles, 70% gravel, 25% sand, 5% silt.
22/26						14.1 DAKOTA SANDSTONE, SILTSTONE, dark gray, fragments on center bit, drilling hard, auger refusal
16/26						Total depth drilled was 14.2 feet.
32/38						
0/6						
9/25						
25/0"						

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File: 9211.log

Date Drawn: 02/07/1994

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MONITORING WELL COMPLETION LOG P92-08

Project: Monticello Mill Tailings Site
 Location: Monticello, Utah
 Site: Downgradient, just east of Millsite
 Total Depth (ft.): 16.0
 Auger Stem Size (in.): 4.25 ID X 7.625 OD

North Coordinate (ft.): 10,496.9
 East Coordinate (ft.): 23,940.9
 Ground Elevation (ft. MSL): 6804.9
 Measuring Point Elev. (ft.): 6807.4
 Auger Head Size (in.): 8.0

Date Drilled: 10/04/92
 Drilling Method: Hollow-Stem Auger
 Sampling Method: Split Barrel, 3.0 in. X 24 in.
 Development Date: NA
 Water Level (ft. BGL): Dry, 10/04/92

WELL INSTALLATION
 Blank Casing: 2.0 in. Trilok SCH 40 PVC
 Screen: 2.0 in. Trilok SCH 40 PVC
 Slot Size: 0.010 in.
 End Cap: 2.0 in. Trilok SCH 40 PVC
 Grout: Enviroplug
 Sealant: 1/4 in. Enviroplug Pellets
 Sand Pack (U): #20-40 Silica Sand
 Sand Pack (L): NA

INTERVAL (ft.)
 +2.46 to 12.0
 12.0 to 14.5
 14.5 to 14.85
 2.0 to 10.5
 10.5 to 11.5
 11.5 to 16.0

BIT SIZES (in.)
 Not Applicable

SURFACE CASING (ft.)
 4.0 in. Protective Steel from +2.78 to 2.22
 Cement Pad from +0.43 to 2.0

Comments: CME-75 Drill Rig

Depth (ft.)	Blows/8-in.	Sample Int.	Sample No.	Well Completion Diagram	Graphic Log	Description
						Logged By: D. Traub
6-12			soil			
25-40			samples			SILT, sandy, dark brown (7.5YR 4/2), no pebbles, dry, roots, stiff, slow to no reaction with HCL. At 2.0 feet becomes more silty sand.
12-30			not			
31-38			saved			2.7 SILTY SAND, slightly clayey, 10% scattered pebbles to 1/2 in., very stiff, slow reaction to HCL.
11-46						4.5 GRAVEL, fractured sandstone cobbles with dark brown (7.5YR 3/2) clayey silt / fine-grained sand, dry, very stiff, fractured igneous pebbles in shoe.
55-50						6.0 GRAVEL, silty, sandy, pebbles to 1 1/2 in., dry.
16-28						7.3-7.7 Very clayey matrix, black, very low plasticity.
29-32						8.0 No recovery due to white/light gray arkosic sandstone fragment stuck in shoe.
10-40/3						
Drilled						
16-12						10.8 PEAT, black, fossil plants visible on fracture faces, light.
12-24						11.6 GRAVEL, silty, sandy, dark brown, igneous and sandstone pebbles, rounded, moist.
10-50/4						
Drilled						
8-20						12.0-12.85 DAKOTA SANDSTONE, COAL (lignite), black, very friable, light weight. Some fine coaly material at 14.0-14.5 feet.
31-40						14.5 SILTSTONE/CLAYSTONE, gray, some small (.5 mm) pyrite crystals on fractured surfaces.
						Total depth drilled was 16.0 feet.

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File: p9208.log

Date Drawn: 02/07/1994

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SOIL BORING LOG SB 92-06

Project: Monticello Mill Tailings Site
 Location: Monticello, Utah
 Site: Downgradient, just east of Millsite
 Total Depth (ft.): 30.5
 Auger Stem Size (in.): 4.25 ID X 7.625 OD

North Coordinate (ft.): 10,044.4
 East Coordinate (ft.): 23,963.3
 Ground Elevation (ft. MSL): 6811.4
 Auger Head Size (in.): 8.0

Date Drilled: 10/03/92
 Drilling Method: Hollow-Stem Auger
 Sampling Method: Split Barrel, 3.0 in. X 24 in.
 Water Level (ft. BGL): -27.0, 10/03/92

Remarks:

Depth (ft.)	Blows/6-In.	Sample Int.	Sample No.	Graphic Log	Description
					Logged By: D. Traub
4-5	X		soil		SILT, sandy, dark brown (7.5YR 4/3), slightly clayey, fine-grained sand, dry, strong HCL reaction, roots and minor caliche increasing to 2.0 feet.
8-9	X		samples		
4-7	X		not		2.0 Clay content slightly higher than 0-2 foot interval, caliche increases to 3% and is in fractures and filling in worm holes.
8-8	X		saved		
5-7	X				4.0 SILTY SAND/SANDY SILT, slightly clayey, dark brown (7.5YR 4/3), very fine-grained sand. 4.0-6.0 feet, moisture increases and scattered gray siltstone pebbles to 1/2 in.
6-7	X				6.0 Same, moist, strong reaction to HCL. 1.1 foot of sample recovered (compressed).
4-6	X				
6-5	X				8.0 SANDY SILT/SAND (very fine grained), minor clay, dark brown, low plasticity, no caliche, strong reaction to HCL, moist, siltstone fragments and pebbles to 1/2 in. from 9.0-10.0 feet.
2-3	X				
4-5	X				10.0 SILT, sandy, little clay, very fine-grained sand, 20% dark gray siltstone fragments, very strong HCL reaction, no caliche. 1.1 foot of sample recovered.
3-5	X				
5-6	X				12.0 SANDY SILT/SILTY SAND, dark brown (7.5YR 5/4), softer and more saturated in sandy zones. 1.4 foot of sample recovered.
1-4	X				
5-5	X				14.0 Saturated in sandy zones, very moist in silty zones.
2-2	X				
5-6	X				16.0 Very silty with abundant siltstone fragments horizontally bedded.
6-8	X				16.0 SANDY SILT/SILTY SAND, matrix approximately 70% around siltstone fragments (dark gray), several fractured light brown sandstone fragments to 3 in., fine-grained sand, moist, firm.
18-14	X				
6-3	X				
5-10	X				Slightly more clay at 19.7 feet (for 0.1 foot interval), then silt, very fine-grained sand.
5-6	X				20.0 SANDY SILT/SILTY SAND, dark brown (7.5YR 5/4), very minor clay, several very hard light gray siltstone fragments, wet, firm.
7-8	X				
2-3	X				22.0 Same, slightly clayey (low plasticity) in several 0.1 foot intervals.
4-6	X				
5-3	X				24.3 SAND, dark brown (to 24.6 feet), fine-grained sand, no silt or clay, soft, wet.



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File: SB9206.log

Date Drawn: 02/04/1994

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SOIL BORING LOG SB 92-06

Depth (ft.)	Blows/6-in.	Sample Int.	Sample No.	Graphic Log	Description
13-20	X				24.8 SILTY SAND/SANDY SILT, 30% subrounded siltstone and sandstone pebbles to 3/4 in., wet.
11-15	X				26.0 GRAVEL ??, no recovery except for a 3.0 in. igneous rock fragment and several subrounded to subangular igneous pebbles to 1 1/2 in.
32-28	X				
10-14	X				28.0 GRAVEL, sandy, saturated, 80% of pebbles (igneous/sandstone) 1/2 in., silty from 29.5-30.0 feet. Very wet/saturated gravels above bedrock.
11-12	X				
30					
5-21	X				30.2 DAKOTA SANDSTONE, CLAYSTONE, dark gray.
33/5"					Total depth drilled was 30.5 feet.
35					
40					
45					
50					

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File: SB9206.log

Date Drawn: 02/04/1994

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SOIL BORING LOG SB 92-07

Project: Monticello Mill Tailings Site
 Location: Monticello, Utah
 Site: Downgradient, just east of Mill site
 Total Depth (ft.): 14.0
 Auger Stem Size (in.): 4.25 ID X 7.625

North Coordinate (ft.): 10,337.6
 East Coordinate (ft.): 23,928.6
 Ground Elevation (ft. MSL): 6,797.8
 Auger Head Size (in.): 8.0

Date Drilled: 10/04/92
 Drilling Method: Hollow-Stem Auger
 Sampling Method: Split Barrel, 3.0 in. X 24 in.
 Water Level (ft. BGL): -7.4, 10/04/92

Remarks:

Depth (ft.)	Blows/6-in.	Sample Int.	Sample No.	Graphic Log	Description
Logged By: D. Traub					
12-14	X		soil		GRAVEL, silty, sandy, dark brown, igneous pebbles, some (0.2 foot) brown sandy silt on the surface.
17-8	X		samples		1.7 SANDY SILT, dark brown, very fine-grained sand, moist, stiff, igneous gravel may be fill material, not the same type of gravel as in the creek bed.
4-5	X		not		2.0 SANDY SILT/SILTY SAND, dark brown (7.5YR 3.2), slightly clayey in thin 1/2 in. layers, very fine-grained sand, moist, firm, no HCL reaction except for 2% caliche from 2.0-3.0 feet, minor caliche from 3.0-4.0 feet.
6-8	X		saved		4.0 SANDY SILT/SILTY SAND, dark brown, very fine-grained sand with minor low plasticity clay, firm, wet, no pebbles or caliche present.
3-3	X				6.3 GRAVEL, sandy, silty, with 60% pebbles to 3/4 in., wet, scattered pebbles to 2 in., subrounded to subangular.
5-6	X				7.4 SAND, very silty, dark gray, 20 % pebbles to 1 1/2 in., saturated.
8-9	X				8.0 GRAVEL, silty, sandy, grading from very fine-grained sand to pebbles 3 in. across, igneous and sandstone pebbles, subrounded to subangular.
3-7	X				10.0 No recovery, sampler refused, large boulder.
5-14	X				12.0 GRAVEL, sandy, well graded, saturated to 13.2 feet.
22-19	X				13.2 DAKOTA SANDSTONE, CLAYSTONE, gray.
50/3"					Total depth drilled was 14.0 feet.
BOUNCED					
3-6	X				
18-26	X				

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File: SB9207.log

Date Drawn: 02/04/1994

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SOIL BORING LOG SB 92-08

Project: Monticello Mill Tailings Site
 Location: Monticello, Utah
 Site: Downgradient, just east of Millsite
 Total Depth (ft.): 30.9
 Auger Stem Size (in.): 4.25 ID X 7.625 OD

North Coordinate (ft.): 9959.7
 East Coordinate (ft.): 23,899.0
 Ground Elevation (ft. MSL): 6822.5
 Auger Head Size (in.): 8.0

Date Drilled: 10/15/92
 Drilling Method: Hollow-Stem Auger
 Sampling Method: Split Barrel, 3.0 in. X 24 in.
 Water Level (ft. BGL): NA

Remarks:

Depth (ft.)	Blows/6-in.	Sample Int.	Sample No.	Graphic Log	Description
Logged By: D. Traub					
3-8			soil		SAND, silty, dark brown (7.5YR 4/3), fine grained, dry, slow to moderate HCL reaction, few pebbles, minor caliche.
9-9			samples		
7-10			not		2.0 Same, brown to dark brown, dry, small roots, caliche on fractures and root/insect/worm holes.
10-9			saved		
7-11					4.0 Same, stronger HCL reaction.
12-16					
8-9					6.0 Same, abundant caliche, several small pebbles (sandstone, igneous, and claystone to 3/4 in. [2-3%]), very strong HCL reaction.
13-15					
13-14					8.3 SAND, light gray (10YR 6/1), claystone fragments present, 30% sand, strong HCL reaction.
14-16					9.1 SAND, silty, brown (7.5YR 5/4), fine grained, dry, 5% pebbles at 1/2 in., minor caliche, strong HCL reaction.
10-11					10.0 SAND, silty, light brown (7.5YR 6/4), fine grained, scattered siltstone/claystone pebbles, very strong HCL reaction.
13-15					12.0 No sample collected, sampler broke and drillers had to overdrill to 13.5 feet to retrieve.
Drilled					
Drilled					
9-15					14.0 SAND, silty to slightly silty, fine grained, 5% fractured claystone fragments to 3/4 in., very strong HCL reaction. Very little silt from 14.7 to 15.2 feet.
18-16					
11-17					16.7 Claystone fragments, angular, 40%.
20-24					
14-17					18.4 SAND, brown (7.5YR 5/4), 20% coarse grained, slightly moist, moderate HCL reaction (18.0-18.4 feet), slight HCL reaction (18.4-20.0 feet), very firm, color grades from light brown to brown over 0.2 foot interval at 18.3 feet.
21-29					
11-19					20.0 SAND, silty, clayey, dark brown (7.5YR 4/4), very fine to fine grained, no HCL reaction, white calcareous material (3%) on fracture surfaces (strong HCL reaction), scattered gypsum crystals at 21.5 feet, subrounded, 1/2 in. igneous pebbles at 20.3 feet.
26-34					
17-21					22.0 SAND, very silty, clayey, strong brown (7.5YR 4/6), moist, low plasticity, slightly less calcareous/caliche white material on fractures than at 20.0-22.0 feet, very stiff.
30-40					
12-14					24.4 SAND, silty, brown (10YR 5/3), dry to slightly moist. 1 in.

SOIL BORING LOG SB 92-08

Depth (ft.)	Blows/6-in.	Sample Int.	Sample No.	Graphic Log	Description
16-24	X				25.8 1 in. layer of subrounded to angular, igneous pebbles to 1/2 in. 60% pebbles from 25.8-25.9 feet, then decrease in pebbles to predominately sand, minor HCL reaction.
15-34	X				
50/5"	X				27.2 GRAVEL ??, Sampler refusal, sampler contained 0.2 foot of igneous pebbles to 3.0 in., rounded to angular.
33-50/4	X				28.9 Sampler refusal, igneous pebbles to 3 in, subrounded to subangular, rock fragment was stuck in tip of sampler, very hard drilling.
Drilled					
30					30.5 DAKOTA SANDSTONE, SANDSTONE, white, very hard drilling (bit teeth were damaged).
50/5"	X				
					Total depth drilled was 30.9 feet.
35					
40					
45					
50					
















SOIL BORING LOG SB 92-12

Project: Monticello Mill Tailings Site
 Location: Monticello, Utah
 Site: Downgradient, just east of Millsite
 Total Depth (ft.): 14.0
 Auger Stem Size (in.): 4.25 ID X 7.625 OD

North Coordinate (ft.): 10,438.2
 East Coordinate (ft.): 23,931.9
 Ground Elevation (ft. MSL): 6798.7
 Auger Head Size (in.): 8.0

Date Drilled: 10/04/92
 Drilling Method: Hollow-Stem Auger
 Sampling Method: Split Barrel, 3.0 in. X 24 in.
 Water Level (ft. BGL): 6.0, 10/04/92

Remarks:

Depth (ft.)	Blows/8-in.	Sample Int.	Sample No.	Graphic Log	Description
					Logged By: D. Traub
3-6	X		soil		SANDY SILT/SILTY SAND, slightly clayey, dark brown (7.5YR 4/2), very low plasticity, dry, stiff, strong HCL reaction.
8-11	X		samples		
7-9	X		not		2.1 SAND, slightly silty, very fine grained, slightly moist, some roots, soft. At 2.7-2.9 feet sandy, slightly clayey, dark brown silt. More sand in sampler shoe. Elevated radiation levels in this zone.
7-4	X		saved		
2-2	X				4.0 SAND, very silty in 0.3 foot intervals, dark brown, moist. At 5.4 feet, 0.1 foot (1.2 in.) layer of wood (doesn't look like roots). Below to 6.0 feet, very silty sand, slightly clayey, dark brown, low plasticity. Several subrounded to subangular igneous pebbles in sampler shoe to 1.5 in.
3-5	X				
3-8	X				6.0 GRAVEL, sandy, dark brown to 8.0 feet, very minor silt or clay, igneous pebbles, subrounded to subangular to 2 in., 75% of material is 1/2 in. or smaller in diameter, saturated.
9-12	X				
8-7	X				
12-20	X				9.2 SAND, silty, dark gray, with a few scattered pebbles.
13-38	X				10.0 GRAVEL, sandy, dark brown, with fractured light gray sandstone and igneous (diorite) pebbles/cobbles to 3 in., saturated, siltier at 12.0 feet.
26-29	X				
3-10	X				
11-8	X				
13.7					13.7 DAKOTA SANDSTONE, CLAYSTONE, dark gray. At 14.0 feet, iron staining (rust) on fractures.
					Total depth drilled was 14.0 feet.

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File: SB9212.log

Date Drawn: 02/04/1994

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SOIL BORING LOG SB 92-15

Project: Monticello Mill Tailings Site
 Location: Monticello, Utah
 Site: Downgradient, just east of Millsite
 Total Depth (ft.): 21.25
 Auger Stem Size (in.): 4.25 ID X 7.625 OD

North Coordinate (ft.): 10,10.2
 East Coordinate (ft.): 24,005.2
 Ground Elevation (ft. MSL): 6802.5
 Auger Head Size (in.): 8.0

Date Drilled: 10/03/92
 Drilling Method: Hollow-Stem Auger
 Sampling Method: Split Barrel, 3.0 in. X 24 in.
 Water Level (ft. BGL): 17.2, 10/03/92

Remarks:

Depth (ft.)	Blows/8-in.	Sample Int.	Sample No.	Graphic Log	Description
Logged By: D. Traub					
5-7			soil		SILTY SAND/SANDY SILT, stiff, dark brown (7.5YR 4/3), very fine-grained sand, slightly moist, stiff, slight HCL reaction near the ground surface, stronger reaction at 2.0 feet, no pebbles or caliche. 1.3 feet of sample recovered (compressed).
8-11			samples		
5-7			not		
9-10			saved		
8-8					4.0 SILT, sandy, slightly clayey to 5.5 feet, dark brown. 1.0 foot of sample recovered (compressed).
8-9					5.5 Gradual color change to brown (7.5YR 4/2), 3% scattered pebbles to 1/5 in., 10% caliche on rootholes, slightly moist, stiff.
3-7					6.4 SAND, silty, dark brown (7.5YR 4/3), softer than above, but firm. Soft at 7.6-8.0 feet, very fine-to fine-grained sand, 5% blebs of light gray silt to 1/2 in. from 7.0-8.0 feet. 1.5 feet of sample recovered.
7-8					8.0 Same, dark brown, very silty, slightly clayey, low plasticity, fine-grained sand. Some layers (separation of layers not defined) consist of more silt than sand, moist, strong HCL reaction. 1.7 feet of sample recovered.
3-3					10.0 More silt than sand, saturated from 10.4-10.8 feet.
4-6					10.8 CLAYEY SILT, slightly sandy, dark brown (7.5YR 4/3), low plasticity, very moist, stiff.
2-2					12.0 Same, 20% very fine-grained sand, low plasticity, no HCL reaction. At 13.8 feet, more sand (fine grained) than silt, dark brown, wet, sand layers are more saturated.
3-5					14.0 CLAYEY SILT to SILTY CLAY, dark brown (7.5YR 4/3), very moist. At 14.8, 1.0 in. layer with 20% subrounded igneous and siltstone pebbles to 1/2 in.
2-4					17.2 GRAVEL, sandy, grayish brown, igneous and sandstone pebbles to 3.0 in., 60% of pebbles are 1/2 in. or less, fine-to coarse-grained sand, saturated, 5% black oxidized material.
6-6					
2-10					20.0 SANDY GRAVEL, igneous and sandstone pebbles, poorly graded (medium-grained sand to 1/2 in. pebbles).
21-34					
18-26					21.0 DAKOTA SANDSTONE, CLAYSTONE, dark gray, some iron staining.
22-46					
10-24					Total depth drilled was 21.25 feet.
50/3"					

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File: SB9215.log

Date Drawn: 02/04/1994

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Appendix C

Hydrographs for wells 88-85, 92-11, 92-07, and P92-08

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